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The small Mallet compound locomotive that was limited in its action capacity and application was a long time in convincing the world that it could be duplicated in large dimensions to advantage. When the big Mallet was put upon the Baltimore & Ohio, people pricked up their ears and wondered what was going to happen.

Now, however, the pattern is turning up in all parts of the world. In addition to the engines built for the Baltimore & Ohio, Great Northern, Southern Pacific, Erie and Virginian railways and to the growing tendency to use Mallets for regular road work as well as for special service, articulated compounds have been built for roads in Brazil, France, China and Tunis.

It has been the custom to avoid mention of patented manufactured articles by name in discussions on the floor of the convention. Mr. Vaughan pointed out in his presidential address that this is not always a wise precedent. The members either do or do not know what kind of a coupler, safety valve, sander or automatic stoker the speaker is talking about. If they do know, reference to it by name will not hurt anybody; if they do not know, they are not getting much good out of the discussion. The more definite and explicit the discussions can be made, the better for all concerned. If a certain manufacturer comes in for criticism, it will save him worry to have that criticism as early as explicit. For his own good in perfecting a marketable product, the criticism cannot be too explicit.

The importance to the motive power department of widening the gage of track on curves was set forth in an outline of some very incomplete data that might be called a report of progress on the matter in connection with the regular report. We all recognize the jar and blow that is occasionally received when a car wheel strikes a heavy blow upon a guard rail and is violently set to one side, but it is rather startling to learn that, from actual measurements, this is liable to be 60 per cent. more of the pressure required to put the wheel on the axle. The fact is that, up to the present there has never been any thoroughly systematic investigation as to the proper widening of the gage of rails, nor is it probable that such an investigation would show that any rate of widening would be best for all types of rolling stock, but it ought to show that widening by some definite formula would give the best average condition of operation. For example, it can hardly be possible that a four-wheel, short base freight truck, a six-wheel passenger truck and a consolidation locomotive would call for the same amount of widening, but by grouping the best arrangements for each it would probably be possible to strike a compromise average that would give the best obtainable working condition of track. As matters stand there is no regular rule for gage widening, and each road and each engineer is a law unto itself. Usually there is a fixed increase of gage for curves in their certain limits based upon the rule of thumb of what will do. It is, therefore, quite proper that the committee should be continued, and it is to be expected that the representatives of the three interested associations will decline to make definite recommendations until they have acquired reliable information upon which to base them. This information can only be obtained by a careful investigation through a wide range of conditions.

Professor Goss has again added a classic to the proceedings of the Master Mechanics' Association, in presenting his paper on Locomotive Performance under Saturated and Superheated Steam. For work done on boiler evaporation, smokebox arrangement and superheated steam, it is impossible to overestimate the value of the services of the Purdue University laboratory, not only to the railways of this country, but to those of the world. As far as this work has been carried, it has been so thoroughly done that nothing more is required on the subject but to extend the range of the experiments, in order to ascertain whether the ratios and laws that appear to have been developed will hold for higher degrees of superheat than those obtainable on the Purdue locomotive, as well as upon larger machines. As it stands, the work holds for the comparatively small locomotives used on the testing plant, and the point was well raised in the discussion that it is quite possible that different results in detail would have been obtained where the percentage of loss of heating surface due to the installation of the superheater was not as great as on the engine under consideration. This was offered as an explanation of the fact that on some large locomotives better results were obtained on the road than in the testing plant. But, taking the evidence of the report, the supplementary report and the discussion, it is evident that the superheater is firmly established as an attachment to the locomotive. The point now to be determined definitely is the relative efficiency of the superheater and the compound. This matter has been investigated to a certain extent in Germany, with the result that the Russian railway administration has decided that the superheater gives better results than compounding, and that it is hardly worth while to apply a superheater to the compound, though here, too, is a point upon which we need "more light."

In his annual address President Vaughan emphasized a point which has often been brought out in these columns; that is, the advantage which might accrue to the national associations by availing themselves more freely of the services of the numerous railway clubs in the discussion and settlement of details apparently of minor importance, but which in the aggregate constitute the substance of the whole matter under consideration. Obviously, it would be absurd for a legislative body to give initial consideration to proposed legislation while sitting as a committee of the whole, and the same principle applies to these national organizations which meet but once a year. The railway clubs meet once a month. Their membership is composed in large part of the men who are actually doing things. They are therefore in far better

condition to discuss intelligently details with which the administrative officer may once have been familiar, but of which his knowledge has been rendered hazy by the absence of actual every-day contact with them, or perhaps rendered wholly worthless by changed conditions. Many of the men in the clubs have this actual up-to-date knowledge and experience. In any case, the clubs have much more time at their disposal. In any case, also the clubs would welcome the reference to them of knotty details which have to be solved as a step in the solution of a more general problem. Referring again to the practice of legislative bodies it is true that the national railway associations have their committees to which special topics are referred; but the composition of these committees is ordinarily and necessarily, and the geographical location and environments such that their work is incomplete. Without disturbing the practice as it relates to the appointment of committees, it is undoubtedly true, as was clearly stated by President Vaughan, that much better results could be obtained by a reference of questions to a railway club than by the always unsatisfactory course of issuing a circular of inquiry to members. What a committee wants to know, and what the association wants the committee to be able to tell it, is not what the various members are doing and how many of them are doing it in the same way, but what is the best line of practice. This is a matter for more consideration in detail than any committee can ordinarily give to it.

THE PROPOSED M. C. B. CONSTITUTIONAL AMENDMENTS.

It is not a criticism, it is high commendation, of the work of the Master Car Builders' Committee on Revision, to note that it proposes a centralization in the Executive Committee of power more complete than that held by the executive department of any civilized nation. It is comparable with the control exercised by the board of directors of a corporation. A summary of these powers is interesting: The Executive Committee admits active members or refuses them admission; passes on the eligibility of present active and associate members; drops, for cause, any member from his membership; recommends the amount of annual assessment; makes all purchases and contracts; elects the secretary; conducts the annual convention; appoints the standing and special committees; fills vacancies; is an absolute censor of all communications, drawings and reports before their submission to the convention, and, of course, decides what shall appear in the printed Proceedings.

To be the whole thing? Yes, and wisely so in all the details of management of the purely business part of an association with a widely scattered membership. The railways and the active members are intensely interested in securing economic and scientific results. The ideal organization is one which chooses with care an absolutely trustworthy committee to do all the executive work, to filter out the time-wasting absurdities and give a clear channel for facts and opinions.

There is proposed a serious change which enlists our sympathies but should not affect our judgment. When a member becomes no longer eligible he should not remain a member. If the lack of eligibility is slight, or technical, or involves only a very few persons, it can in almost any club or organization be properly ignored. But when the distinction is vital and involves many members it becomes an abuse of privilege to retain a badge which implies an untruth. There is a distinct difference between the functions of officers of companies who own and operate cars and those who make cars and parts of cars for sale. Their interests are in one sense opposed; one is a buyer, the other is a seller. Their meeting together at Atlantic City is a distinct benefit. There is an interchange of knowledge of the requirements of railway working and of the commercial limits of manufacturing, going on all the while, which bridges a gap and checks error. The experience of many convention years has proved its great value. Indeed, an unobservant person might say that the broadest view and the wisest decisions might be got from an association with a membership consisting of both makers and users. This has a basis of right reason, but such a plan is not workable.

The defect in the present mixed membership is the injustice of it. One manufacturer, who was formerly a railway officer and elected to membership for that reason alone, continues to hold his badge, to attend convention meetings, to vote on certain questions, to receive during the year advance notices enabling him to keep close watch on the tendency of committee investigations, and, in a way, to "affiliate" at the conventions as his competitor cannot do. All these things have a money value. They give an unfair advantage both in designing materials, manufacturing and selling. It seems rank.

The pitiful part of it is the real loss to the membership of able men whose contributions to the work of the association have been great and who will always hold the esteem of their fellow members for their services in building up the organization from small beginnings to high accomplishment. The temptation is almost overwhelming to yield a little, or to find some plan for retaining these important members. Many such have been suggested, but first principles need to be regarded. It is unfair; it is wrong. A member who is not eligible should not retain his membership.

The principal objections to superheaters which have been made at previous conventions appear to have been successfully overcome, and this year opinions are all entirely favorable to the superheater. As now constructed, no unusual repairs are required in the piston or valve packing rings or the rod packing, and the repairs and maintenance of the superheater itself is not the serious item it was once regarded. Reports were given of locomotive superheaters which have been in service a year without repairs, and the delays to passenger trains operated with such engines were less than with those not so equipped. The discussion brought out an expert opinion from Mr. Vaughan, which explains the situation in a few words and is valuable as coming from so reliable an authority. He said, "there was no question as to the advisability of using superheaters on passenger engines because it so increased the capacity of the locomotive that it prevented delays on the road, with schedules which the ordinary engine maintained with difficulty, and this was true regardless of the quality or price of coal." As to the use of the superheater on freight engines, that depended more on the cost of coal, and his advice would be to equip passenger engines first and after gaining an extensive experience with them it would be time enough to consider the application of the superheater to freight engines. The principal reason for this was pointed out in Professor Goss' paper, when he explained that in freight service the engine is standing on track and not using steam such a large per cent. of the time that it cannot realize an economy which is dependent on the use of steam. The portion of Professor Goss' admirable paper which relates to the tests of the Purdue locomotive as equipped with the superheater has been printed in a previous issue of our daily edition. In Professor Goss' absence it was presented in abstract by Professor Schmidt, and his selections were so wisely chosen that the gist of the paper was readily obtained without unduly occupying the time of the convention. The paper contains a diagram showing the heat balance of the locomotive with superheater which is perhaps the first ever published for a test made in the laboratory, and it is suprising to find that the heat losses unaccounted for amount to only 5 per cent. and the radiation loss is assumed to be only one per cent. This may be compared with the heat balance made by Professor Hitchcock of Terre Haute as the result of tests made on a locomotive in service. These tests were made about 1905 and may be found in the proceedings of the American Society of Mechanical Engineers. The losses by radiation from a locomotive in service may also be found in Professor Goss'

report on Locomotive Laggings, giving results of tests made on the Chicago & North Western Railway.

The vexed questions connected with the proper construction of tender trucks are apt to be answered by generalizations from insufficient data, and the report of the committee on this subject contains some opinions and statements which might easily be questioned by another committee. The principal point is to secure a design which will not cause derailment at high speeds and on poor tracks. It is generally admitted that a mistake was made in increasing the capacity of the tender by retaining the short wheel base of light tenders and enlarging vertically. These short and high tenders are easily derailed, and this has been attributed to various other reasons, and conditions have been improved by changes in truck construction. Some lines have overcome the difficulty by one modification, and other lines by a different one, and each has concluded that it has discovered the real cause of the derailments. It is probable that in most of these cases if the total wheel base of the tender had been lengthened and the length of tank increased and its height decreased, the same improvement would have resulted without any changes in the truck. In this way the whole subject has become confused and it is not always safe to draw conclusions as to the best design of tender truck to prevent derailments from individual cases which apparently explain the cause of the trouble. The report takes up this question of tender derailment and the discussion did not bring out any important objections to the conclusions it announces. It recommends that tenders should be as long and low as possible and that trucks be kept as low as consistent with proper track clearance. The report favors the arch bar truck when properly designed, as it is less expensive to build and maintain than the pedestal truck. It objects to the use of coil springs over the journal boxes in pedestal trucks, as they increase the wear of both box and pedestal. The recommendations in regard to side bearings favor their use on each truck, and it is true that general practice is tending in that direction. They suggest 36 in. spread for the front truck and 50 in. maximum for the rear trucks. It does not regard anti-friction center plates and side bearings as necessary, but it is a fact that a considerable reduction of flange wear has been obtained by the use of a good roller side bearing, and they are being used in increasing numbers.

LOCOMOTIVE BOILERS AND FIREBOXES.

TO THE EDITOR OF THE DAILY RAILROAD AGE GAZETTE:

President Vaughan spoke about the enormous consumption of fuel for the locomotives of the United States, amounting in round numbers to about 200,000,000 tons annually, and costing about $80,000,000, and he recommended that superintendents of motive power should give their attention to decreasing the consumption of fuel on the locomotives, which is surely timely and good advice.

It is a well-known fact that the duties of a superintendent of motive power are so numerous that it is next to impossible for him to take time to look into what might be a great assistance in accomplishing the purpose recommended by the president in his address.

It is a well-known fact, also, that a great amount of labor, time and ingenuity have been spent on improving the engine part of the locomotive for economical working, but it appears to me that we shall have to look more to the boiler than to the engine in the future. The fireboxes of locomotive boilers have been extended, as well as the grate surface, in order to get results, at the expense of fuel. What is requisite for economy is not to increase the size of the firebox and the grate surface, but to increase the direct heating surface in the regular size fireboxes and tube plates. It has been conclusively proved that this can be done by flanging to an extent of from 20 to 30 per cent., and in flanging, as is shown on the fireboxes which I have designed, you will note that the natural tendency of the steel to expand and contract is fully taken care of, and by its formation the box is made over 50 per cent. stronger than if made in the regular form with flat plates, bound up with stays, so that the natural expansion of steel cannot exert itself.

It must not be lost sight of that we shall have to devote our attention to eliminating all horizontal and vertical riveted seams in fireboxes that can be dispensed with in order to allow the strains set up by contraction and expansion to be neutralized; and the reduction of stays is an important factor, consistent with taking care of the heavy pressures at which the boilers are worked.

It will be noted that such firms as Worth Brothers Company and the Otis Steel Company, especially, are increasing the size of their rolls, so as to roll firebox sheets 146 in. wide. From this fact it appears that there is to be a demand for fireboxes made from one sheet.

In conclusion, I may say that the results I have obtained in my efforts to get this increased surface in the firebox and tube plates, reducing the number of stays and economizing fuel to an extent of at least 15 to 20 per cent., have been very satisfactory.

WM. H. WOOD,
Engineer, Media, Del. Co., Pa.

THE RAILWAY BUSINESS ASSOCIATION.

Letters from several high railway officers urging that the interest which sells to railways should combat legislative and other attacks in an organized way, have been received by the Railway Business Association, which has a booth next the registration desks. The writers congratulate the association, which is composed of equipment and supply concerns, on its achievements in "preventing much legislation and tempering and toning down considerable of that which finally became effective." Besides Mr. Brown other writers of such letters are Presidents Elliott, Northern Pacific; Underwood, Erie; Johnson, Norfolk & Western; and Winchell, Rock Island; Vice-Presidents, Besler, Central of N. J.; Willard, C. B. & Q.; and C. S. Clarke, Missouri Pacific; and W. B. Scott, assistant to J. Kruttschnitt, director of maintenance and operation of the Harriman lines.

W. C. Brown's letter is in part as follows:

"I want to congratulate the members of the Railway Business Association on the excellent work they have done, and the very powerful influence they have exerted, in preventing much legislation, and tempering and toning down considerable of that which finally became effective. Important and valuable as the work of your association has been thus far, I believe, if cordially supported, it is just starting in on its greatest field of usefulness.

During the past four or five years, the country has been in a sort of hysteria, or frenzy of corporation regulation, which in some cases, has almost amounted to corporation persecution.

I believe that a great majority of our people, and especially of the business interests of the nation, recognize that at least the spirit in which some of this regulatory legislation has been passed was a mistake, and while agreeing that the regulation of the railways and other great corporations doing interstate business is necessary and that no backward step in this connection will be permitted, I believe all are united in the opinion that this regulation should proceed along orderly, sane and conservative lines, and not be the result of hysteria, anger or a spirit of retaliation.

If I am correct in my diagnosis of the situation the next two or three years are going to be of very great importance to the people, as well as to corporations, because it seems certain it is going to be a formative and constructive period.

In the discussion of the question of the regulation of

corporations there will be extremists on both sides,—those who will advocate the most extreme restrictive and repressive measures, the passage of which will not only seriously impair the efficiency of the great transportation interests, but in doing so embarrass and hamper the growth of hundreds of other industries that are dependent for success upon the highest class of transportation service. On the other hand, there will be those that will oppose regulation of any kind, or seek to hedge about legislation looking to the regulation of corporations in such a manner as to make it ineffective and of little value.

Somewhere between these two extremes must be found a middle ground on which representatives of both interests who are disposed to be fair can meet; and in selecting this middle ground and using your good offices in drawing the opposing forces thereto, in my mind, your association can be of the utmost value, not only to your own members but to the country as a whole."

HEAT TRANSFER.*

BY PROF. CHARLES E. LUCKE,
Columbia University.

One of the movements, perhaps more powerful than the others, which together marked the creation of the profession of mechanical engineering from the trades of machinist and millwright, was the derivation and application of the laws of heat and work, that is to say, the birth of thermo-dynamics. A study of the relation between cause and effect in the heat relations involved the setting down of the reuslts of innumerable experiments, from which a few minds were able to draw generalizations or laws. These laws, based upon experimental observations and facts, and strengthened by repeated confirmation in more and more varied forms, made possible the prediction of results from assumed data, and thus reduced the design of machinery involving the relation of heat and work to a science as exact as it is possible to set down the data representing imposed conditions. We have now much literature on the subject of thermodynamics and universal acceptance of its laws among mechanical engineers, but this literature and these laws generally accepted relate almost entirely to transformation of heat and work energy each into the other form. It very seldom happens, however, that we are called upon to deal with machinery or apparatus in which the heat questions involved are solely those of transformation of energy. The doing of work at the expense of heat involves the use of a gas or vapor as a medium of transformation, or more definitely, as the transformer itself. In our dealings with vapors we are forced to handle a liquid as the origin of the expansive fluid, which is the real transformer. No matter what the medium of transformation, or whatever the transformer, to use this term, which seems so valuable, it is necessary as a prime initial condition that heat be applied to it. There is no way of applying the heat directly to the working fluid except by internal combustion. In the great mass of real, everyday cases the heat must be applied through plates or tubes or through metal containers. In order to complete a cycle, as a consequence of which the heat is transformed into work, there is necessary not only the heat addition period, but also a heat abstraction period, for without it the cycle cannot be completed, that is to say, the transformer cannot be returned to its original condition. This may involve more heat passing through metal containers or tubes in condensers. It thus appears that the practical transformation of heat into work will generally, and always in the case of steam, involve not only the laws of thermodynamics, but also laws, if such there be, of heat flow or transfer. To this problem of heat flow comparatively little attention has been paid, and the master mind capable of consolidating into laws such isolated and scattered data as are available has not yet appeared.

Great as is the importance of the problem of transformation in our practical engineering work, it must be admitted, after a review of the field, that apparatus involving heat transfer is of more universal use, more diverse in form than the former, so that the importance of a careful study of it is probably correspondingly greater. It seems decidedly worth while to review the situation, apply what feeble analysis we can to it and form a judgment of the present position of the art. What seems to be a transfer law of great importance is often stated in connection with such cases as these, as follows: the heat which will pass from a region of high temperature to a region of low temperature is directly proportional to the difference between those temperatures, to the amount of surface through which it may pass and to the time available. This seems almost axiomatic, and so the coefficient of heat transfer would appear to be a proper measure of the phenomenon, and we find that the B. T. U. per square foot per hour per degree difference of temperature is a basis coefficient in much of the published work on the subject, and designated by U. How strange it is then that the value of U, when derived from experiment or engineering practice, is found to vary from less than 2 to nearly 1,000. That there are such enormous differences warrants an investigation, which, of course, to be complete, would far exceed the limits of any single paper or even book, yet a brief survey of the field may be made with considerable profit. It is interesting to compare the average values of U commonly depended upon in ordinary practice by setting down values against the type of apparatus to which they apply.

Values of $U = 1.8$ are found in refriger cing rooms with still air when either ammonia or brine is in the pipes and this value is increased to perhaps 5 or 6 by a vigorous circulation with air velocities up to 900 ft. per minute. On the average, however, for these refrigerating pipes absorbing heat from and giving it to either liquid brine or evaporating ammonia the value $U = 2.5$ will be found representative. This is very close to the common value of $U = 2$ for steam radiators where heat is passing from condensing steam to mildly circulating air, and likewise close to the values for steam-pipe condensation, which lie between $U = 2.5$ and $U = 4.0$, depending on quite a variety of conditions, such as material, color, surface condition, steam pressure and air circulation. When the heat passes from products of combustion to steam in steam superheaters the average value is about $U = 4$. Economizers have values lying between $U = 2$ and $U = 3.5$, depending on circumstances, and about the same order of magnitude is found in steam boilers, which, however, are somewhat different on account of direct radiation influences.

In tank brine coolers, where the evaporating ammonia absorbs heat from sluggishly circulating brine in the tank covering the pipe coils, the value $U = 10$ is about right when the vapor leaves the coil reasonably dry. This, however, rises to about $U = 14$ when the coil is flooded with ammonia, compelling the vapor bubbles to pass through liquid to the end of the coil. With double-pipe brine coolers evaporating ammonia absorbing heat from circulating brine the coefficient is higher and will lie between $U = 30$ and $U = 50$ for velocities between 100 and 200 ft. per minute. A similar range is found in liquid heat exchangers of absorption refrigerating systems, the value being between $U = 50$ and $U = 60$, depending on the velocity, the latter figure corresponding to a velocity of 650 ft. per minute. This value of $U = 60$ is common to other apparatus involving the passage of heat from liquid to liquid or liquid to evaporating liquid. It applies directly to water and beer coolers, the liquid trickling over pipes with ammonia evaporating inside. When, however, the heat transfer is from liquid outside to circulating brine inside, it rises to $U = 75$. The absorbers of ammonia vapor where the absorption takes place inside and the aqua ammonia is cooled by water inside, the value is again $U = 60$. The same value applies to open-air ammonia condensers with heat flow from condensing ammonia to water trickling over the outside of the coils. Shell type brine coolers and condensers in which brine or water is circulated through coils, and ammonia evaporated or condensed between coil and shell, have a coefficient about $U = 100$. Steam surface condensers similarly constructed have values between $U = 130$ and $U = 120$, depending somewhat on the water velocity, freedom from air and ratio of circulating water to steam. A commonly used value is $U = 180$, reported long ago by Loring and Emery. This same value is used in and found to apply well to some forms of feed water heaters in which the transfer is of the same class as the surface condenser, i. e., heat flow from condensing steam to circulating water, but recent tests of feed water heaters show the same peculiarity as was mentioned in the case of double-pipe brine coolers—a rise of the coefficient with water speed to values close to $U = 1000$, although few designers would think of exceeding $U = 350$ for these heaters. Passage of heat from condensing liquid to boiling liquid at lower temperature is a characteristic of evaporators of single and multiple effect, and for these $U = 300$ is a fair average value. It is interesting to note that this same value also applies to the generators of absorption refrigerating machines, where the heat of condensing steam is given up to rich aqua ammonia liquor.

It appears from this brief review that all those cases in which gases play a part in giving or receiving heat that the values are low and range between $U = 2$ and $U = 4$, the differences being in all probability due chiefly to variation of agitation and velocity within the comparatively small range in which they are likely to vary in steam pipes, radiators, refrigerating-room piping, superheaters, economizers and boilers. In

*A paper presented at the annual convention of the American Railway Master Mechanics' Association.

all cases where liquids are involved and the heat passage between liquid and either permanent liquid, evaporating liquid or condensing vapor that the coefficient is always much higher, but with far more range between the maximum and minimum values, the differences being largely related to the liquid velocity or agitation. This class of apparatus includes brine, water and beer coolers, liquid heat exchangers, evaporators, steam and ammonia condensers and feed water heaters.

This broad division of the subject is very important and useful, as it shows that in every case where a gas is involved the coefficient is very low and where liquids are involved the value is higher and may be very high, indeed. More detailed study reveals, however, the fact that velocity of the fluid seems to exert the most powerful, though a variable, influence on the result.

Perhaps no apparatus offers more direct opportunity for study of the effects of conditions on U than the feed water heater, and in late years a good deal of investigation has been undertaken along these lines. The results, while differing considerably in some respects and often in a most puzzling manner, generally, however, show great increases in U with speed and agitation of the liquid. On each series of tests on a 1⅞-in. copper coil of No. 16 Stubb's gage of varying length is reported below and shows U = 309 for a water velocity of 200 ft. per minute and a coil length of 129 ft., while a value U = 600 was found for the same velocity and a coil length of 184 ft. Decrease of velocity for the short coil to 100 ft. per minute seemed to increase the coefficient to U = 318.

Length.	Water velocity.	Value of U.	Length.	Water velocity.	Value of U.
129	200	309	147	155	340
129	175	307	147	135	460
129	135	310	147	115	430
129	108	316	166	175	583
129	100	318	184	200	600

While in some cases such erratic results can be ascribed to error, there are many others, where, in spite of check runs and differences in mode of measurement, peculiarities persist. One such case was found in another series of feed-water tests with a different type of tubing, in which the coefficient increased quite regularly up to U = 540 for water velocities of 50 ft. per minute, giving a smooth curve. At this point, however, the curve became discontinuous and showed no increase in U up to 60 ft. velocity, at which value a new curve started, having a different slope and gave values of U = 800 for velocities of 150 ft. per minute without showing any signs of a decreasing rate of rise. In another series on the same tubes there appeared to be a reversal, indicating a maximum value for some definite velocity. The really remarkable thing about this series, however, is the proof of the proposition—that given sufficient water agitation, values of U up to 1000 are not at all difficult of attainment, values about three hundred times as great as attained in boilers and other common apparatus involving gases.

A series of tests on a very large and new surface condenser showed the velocity increase of U as is indicated by the following table:

Lbs. circulating water per hour.	Lbs. steam per hour.	U.
7½ million	94 thousand	131
8 "	123 "	140
9⅛ "	140 "	137
— "	143 "	200
12 "	138 "	203

While it is true U seems to be a function of the quantity of circulating water, and hence tube velocity, it curiously enough is more exactly a linear function of the ratio of circulating water to steam, the maximum value of U corresponding to a ratio of 90 and the minimum U to a ratio of 20.

Another series of tests on the relation of U to water velocity was made on two double-pipe brine coolers, with the following results:

Brine velocity.	U.	Brine velocity.	U.
180	42 to 49	150	38 to 43
170	41 " 46	128	33 " 37
164	44.5	115	31.5

The law of variation of U with the cube root of the velocity, announced by Hausbrand, does not hold for this series, for, taking the low value as correct, the calculated high value would be 37.5, as against observed values between 42 and 49. Similar differences appear if any other figure be taken as a standard.

With so much evidence in favor of the probability of a law of relation between water velocity and U when liquids are involved, a series of tests were laid out at Columbia University to show the relations existing between U and water velocity when gases were involved and with somewhat startling results.

A 2-in. tube 88¾ in. long was placed in a brick flue supplied with products of combustion from a gas fire, which permitted the gas temperature to be controlled, and water was circulated in pipe. Table A gives the results that for water velocities between 10 and 80 ft. per minute there is no variation in U at all, a result that is seemingly contradictory. With a view to showing how much influence on this result might be charged to the core action of the water or whether the result was due to only heating the skin of the water stream instead of the whole cross-section, another series was run on the same tube with a 1-in. pipe (plugged) in its center. Examination of the results will show that the core had no effect on the coefficient, so that whatever resistance to heat transfer existed it was not due to coring action of the water, that a rise of velocity to 200 ft. per minute did not result in any variation in U.

The only variable that seems to influence the coefficient is that of gas temperature, which may or may not be associated with gas velocity. It is quite evident from the results that the problem of heating water from hot gases is concerned not at all with the absorption from the metal by the water nor with the transfer through the metal, but, on the contrary, is strictly a question of causing the gas to give up its heat to the metal. To secure some further information on the effect of changes of condition on the gas side, a Foster superheater element was used in the next series of runs in place of the plain tube. If, as seems to be the case with the gases, the low coefficient is due to an insulating layer of gas next the metal, then with this Foster element the conditions should be exaggerated, because between the concentric, constituting the element, there will be exaggerated dead gas pockets. An examination of the results show that the coefficient is but little more than a third for the low gas temperature and about one-fourth for the high gas temperature of what it was for the plain tube without the ribbed surface. Another remarkable thing is brought out, and that is the fact that the coefficient for the low temperature gases vary little, indeed, from that for the high temperature gases. In other words, with this ribbed surface the coefficient is practically constant and independent of both water velocity and gas temperature or may be considered a consequence of gas temperature and gas velocity. For the purpose of verification of the results previously obtained for the effects of a solid core, this same Foster superheater element was provided with a ¾-in. plugged pipe core. A rather curious fact thus revealed is that this pipe core apparently lessened the coefficient, but the coefficient is still independent of water velocity and a function of gas temperature to at least some degree. As a last and final test of the relative importance of the gas and water sides, another series was run with the Foster element fitted internally on the water side with a spiral core to give the water a rotary motion, thus distributing it more effectively with reference to the tube surface. These figures confirm the previous series and make it absolutely certain that in heat flow of this class, no matter what is done on the water side, it has little or no effect on the rate of transfer, proving indirectly the other proposition, which is of vast practical importance—that to increase the coefficient of transfer for a case between gases and liquids attention must be paid to the gas side, and that all such attention to the gas side must be devoted toward the removing of cooled-off gas particles and bringing into contact other heated particles. The importance of this is only properly realized, when it is remembered that rates of transfer obtained betweeen condnsing liquids and liquids run 300 times as great as those obtained between gases and liquids.

Enough has been said in this short review to make it plain—

Firstly, that laws of heat transfer applying to the whole subject do not exist, and

Secondly, that there is a possibility of an enormous improvement in the transfer rate for apparatus involving gases. To take but one instance, that of the steam boiler, it is certainly worth while to study the possibility in all of its phases, whether apparent, probable or improbable, of raising the rate of heat transfer from its low value of 3 or thereabouts to at least 100. Should such a series of tests be successful, and there is every promise that they may easily be, boilers with perhaps 100 times the present capacity might be developed with the same heating surface. It may easily be a secondary consequence that their form would correspondingly change. The desire for steam engines capable of using high ratios of expansion, and yet of low first cost, is one of the principal reasons for the present acceptance and success of the steam turbine. Why, then, may we not hope for a steam boiler with just as much difference between its size per horse-power and that of our present boilers as there is between the size of our steam turbines and the multiple-cylinder reciprocating engines, which they have at least in part replaced? Within the last year there have been reported in the technical transactions two papers bearing on this subject. One presented to the A. I. E. E. by Walter S. Finlay, of the Interborough Rapid Transit Company, of New York City, showed that by the use of double stokers the capacity of the Babcock & Wilson boilers in the Fifty-ninth Street Power Station could be doubled without serious disturbance of efficiency. The only rational explanation of this, assuming the data to be correct on which the conclusions are based, is the difference in conditions at the gas

surface, greater agitation and velocity being the result of passing twice as much gas through the steam passages. Another paper of similar character was presented by John T. Nicholson to the Junior Institution of Engineers of England, in which he describes the results of some experiments on a Cornish boiler, enormously increasing capacity of the surface by increasing gas velocity. While it is true that both of these papers can be criticized on certain grounds, and may, therefore, not be quite conclusive, there is no doubt whatever that they are the beginning of an awakening to a new line of study of vast practical importance to everybody using and designing heat transmission apparatus, but perhaps greater significance to the locomotive man. The locomotive always has been and always will be a peculiar machine, due to the conditions under which it must operate, the like of which exists nowhere else. Investigations have been carried on of recent years to indicate the trend of development from now on, and the question, Shall the boiler steaming capacity be increased or shall its pressure be raised, have both been studied, but are both only parts of the larger question of how shall the capacity of a locomotive be increased? Practically no thought has been given to the question raised by this paper, How may the rate of heat transfer betwen hot gases and water be raised so as to be more nearly commensurate with the rates obtained in handling liquids? Professor Nicholson says, and the experiments on record, including those at the Interborough Power Station, seem to confirm his views qualitatively at least, that the gas velocity must be increased. I am inclined to think that this is but one way of stating a broader proposition announced some years ago by Prof. John Perry, that the gas surface must be scrubbed by hot gases. I urge, therefore, in conclusion, the desirability, almost the imperative necessity, for vigorously prosecuting experiments on large scale apparatus to show the effects on the increase of heat transfer of all sorts of variations of transmission applied to the gas sides of the tubes, which shall be effective in causing the metal surface to be vigorously scrubbed by hot gases.

[The pamphlet also contains a number of tables, giving full results of the tests. Space considerations have made it necessary to omit these tables.—EDITOR.]

SOCIETY OF RAILWAY CLUB SECRETARIES.

The Society of Railway Club Secretaries will hold its 14th annual meeting Saturday morning at 10 o'clock at the Hotel Brighton, James Powell of Montreal, of the Canadian Club, presiding. In his annual report, the secretary-treasurer, Harry D. Vought, of New York, representing the New York and Central clubs, will say, in part:

It has been aptly said that the secretary of a club is the "works" and it is, therefore, fair to assume that in our little society we are the combined "works" which, when kept in good running order and not neglected nor forgotten, will furnish the right sort of power to keep the rest of the machinery in motion; that is, at least, in some measure dependent upon it for effective operation. This is confirmed and emphasized by diversified benefits after we were organized and began to act in concert for the attainment of those ends. Economies that have saved thousands of dollars as compared with the previous expenditures and business methods of conducting club affairs which our superior officers properly look to us to recommend and work out if shown to be practicable, may be cited as among some of the results for which we are entitled to credit.

We are justified in pointing with pride to the undisputed and indisputable fact that it was through our united recommendation that the books of official proceedings, issued by our respective organizations, are of uniform size and that each club has a standard color that is its individual trade mark. The typography of these publications is, also, largely of standard style, character and design, and in gaining their admission to the mails as second class matter, because of the educative character of the literature thus circulated, we have made possible a saving in club revenue that is not to be despised. These are just a few of the good things that this society has accomplished, and that prove that it has very substantial reasons for its existence. Our work in this regard has not and never will be finished, while railway clubs flourish and are recognized, as they now are conceded to be the most valuable auxilliaries of the Master Car Builders and Master Mechanics associations, for the advance solution of problems that are thus simplified for their final settlement in the annual conventions of the larger bodies.

Mention of the restoration of our numerical strength has reference to the promised renewal of affiliation by the Southern and Southwestern Club which is reported to be again in a prosperous condition; also the admission to the Society of the Northern Railway Club which has practically taken the place of the Northwest Club. Our former co-worker, W. E. Rosevear, Jr., is understood to have a new club under way at Winnipeg for the growing Canadian Northwest, and if successful in his effort he will probably be pleased to avail himself of an invitation already given to reunite with us. Attention is being given to a club that we are informed has been organized in Kansas City and our former associate, W. W. Wheatly, who, you will be interested in knowing, has risen to prominence and influence in the traction world, is giving us his co-operation in that direction. The Pacific Coast Club lost its existence as one of the results of the San Francisco earthquake. With the rapid restoration of the city from the effects of that disaster, presumably, those who were formerly active in its affairs, will be led to resurrect that club, because railway men have ever since been without any such organization west of the Rocky mountains.

Your secretary-treasurer at this time, presents for your serious consideration, the advisability of enlarging the scope of this society to the extent of making eligible to membership the secretaries of other distinctively railway organizations. If this is done, we should substitute for our present name that of the American Association of Railway Secretaries. It will, probably, be well to so amend our articles of organization that they will specifically name the railway organizations whose secretaries would be eligible to membership. If this idea appeals to you and the recommendation is adopted, a sub-committee should be appointed with authority to work out the details and make the needed changes in our rules and regulations, the same to be promulgated when the minutes of this meeting are sent to each member.

In the evening, at the palm garden of the Windsor hotel, the members of the society and a number of railway officers and other friends will sit down to the annual dinner. It is expected that John Baulch, ex-president of the St. Louis Club, will present a short paper, but there will be no other speaking. H. S. Hayward, superintendent of motive power of the Pennsylvania railroad and a vice-president of the New York Club, will preside. At 9 o'clock there will be a musicale and vaudeville entertainment for which a thousand invitations are being issued. Admission at the Illinois gate of the Garden will be restricted to those having a card of invitation.

At the reception by the officers of the Master Mechanics' Association at the Marlboro-Blenheim on Wednesday evening, the receiving party was composed of President and Mrs. Vaughan, George W. Wildin, C. E. Fuller and Mrs. Fuller and Angus Sinclair and Mrs. Sinclair. It is a source of much regret that Mr. Wildin was obliged to stand alone in the official ranks. Mrs. Wildin has been a regular attendant upon the conventions for several years, and her charming personality has contributed much to the pleasure of all in attendance and to the popularity of her husband, though the latter was hardly necessary. She is now in the hospital and will not be present during the conventions.

Some of E. G. Buchanan's friends are passing him by without that complete recognition which leads to friendly greetings. On close inspection Mr. Buchanan seems to lack some facial adornments of the past, though he has still many of the same charming characteristics as of yore. Like the Boston Miss who lost her eyeglasses, he feels really immodest without them.

Conventionalities

W. M. Briggs, eastern manager of the Joyce-Cridland Company, is attending the convention.

Ask Angus Sinclair if Jones is running against him for treasurer this year and see him blush and then smile when he recalls who Jones is.

This is the twenty-seventh annual convention for John B. Hicks, the paint and varnish man. Mr. Hicks is a sticker; that is, he's always on the job.

Rosser says he isn't a bird tamer, but he admits readily that the first few days have fitted him for a diploma as a lion tamer.

G. N. Sweringen, of the Chicago Railway Equipment Company, is attending his first convention and is wandering around both night and day in a dazed condition.

E. B. Leigh, President of the Chicago Railway Equipment Company, accompanied by Mrs. Leigh, will arrive from Chicago to attend the conventions the last of the week.

John W. Farssler, of the J. Farssler Mfg. Company, Moberly, Mo., manufacturers of flue expanders, flue cutters, and other boiler makers' specialties, is attending the convention this year.

W. H. Linburg, president, and Welling G. Sickel, vice-president of the United Globe and Rubber Company, are here, making the rounds of the convention and Atlantic City.

C. M. Walsh, President and General Manager of the Falls Hollow Staybolt Company, arrived on Wednesday evening, accompanied by Mrs. Walsh and Miss Brannon of Cleveland.

C. F. Palmer, representing the J. Farssler Manufacturing Company, Moberly, Mo., is attending the convention with Mr. Farssler. Both are stopping at the Marlborough-Blenheim Hotel.

Somebody suggested to the editor that The Daily print a pun about Jack Turner and his pal, Wilkinson. As Jack's a good joke anyway, why not let it go at that? But who is Wilkinson?

P. H. Wilhelm, of the Asbestos Metal Company, an old stager at the conventions, has brought his daughter, Miss Marie L. Wilhelm, for her first visit. They are living at the Traymore.

John T. Brown, vice-president of the Damascus Bronze Company, is attending the conventions, as usual, although he has been ill for several weeks. Friend Brown is now rapidly regaining his health.

James Timms, of Columbus, Ohio, inventor of the Excel coupler, manufactured by the Scullin-Gallagher Iron & Steel Company, is again attending the convention. He has been present at these meetings each year for the last twenty years.

George B. Maltby, of the George B. Maltby Company, finds it impossible to attend the conventions this year owing to the fact that he has added a number of specialties to his business, and the new responsibilities require his presence in Cleveland.

Fred W. Sumner, treasurer of the Knitted Padding Company, who used to attend these meetings regularly, but who has neglected them for some years because he was forced to give his time to other branches of the business, spent Tuesday and Wednesday at the convention.

Major H. C. Howell, manager railway department Fidelity & Casualty Company, New York, is making his customary convention visit. His reports of renewed life in both railway and financial circles are extremely encouraging. In his words, "The sun is beginning to shine."

R. T. Coe, of Detroit, has been dubbed "Siroc-Coe," for while he claims to have left "hot air" at home, the slightest provocation is liable to start a zephyr straight from Sahara. This means Coe, of the Sirocco Co., of "co'se," though the Co. has been absorbed by the American Blower Company.

W. H. Thomas, formerly superintendent of motive power, Southern Railway, showed his appreciation of the courtesy showed him last year, in his election to honorary membership, by being upon the ground nearly a week before the opening of the conventions.

The friends of H. J. Small, general superintendent of motive power of the Southern Pacific, will be pleased to learn that he has recovered completely from the operation he underwent some time ago and is in good health again. Mr. Small, who has been quite a regular attendant at the conventions, will not be present this year.

The battle of clothes, going on between several of our brave friends, seems to have been won by Raymond H. Pilson, who needs no introduction to conventionites. To anyone who is curious to know the reason for Mr. Pilson's success in sartorial warfare we would suggest a careful inspection of the wonderful cuffs on his sleeves.

C. F. Huntoon, of the Joliet Railway Supply Company, is among the faces missing from this year's convention. He is detained at home through illness, but has asked to be remembered to his friends. His side partner, H. M. Perry, another "old timer," is here on the job. Mr. Perry has been attending these conventions for almost forty years.

Although he is only treasurer of the Railway Supply Manufacturers' Association, Bob Weatherly seems to occupy the highest position in the organization. At least that's the impression one gets when he sees Weatherly at his desk—and that's a good part of the time. One thing is certain; he's not on the level while taking in the cash.

B. D. Lockwood, formerly mechanical engineer of the Big Four Railway, of Indianapolis, has resigned to accept a position as assistant chief engineer of the Pressed Steel Car Company, to take effect July 1. Mr. Lockwood has had a railway experience of many years and Charles A. Lindström, chief engineer, should be congratulated upon securing so able an assistant.

There has been some little dispute over the relative merits of the performances of the "Seals" and the "Yellow Labels." As the seals perform most of their stunts in the daytime and under skilful direction, while the performances of their rivals take place at night and in any old direction, it looks as if the followers of the widow Clicquot would come out at least a "head" ahead.

Fred A. Casey, of the Ashton Valve Company, Boston, appears this year in the role of a convalescent from the effects of a railway wreck some two months ago, in which some ribs were broken and internal injuries sustained. Mr. Casey has been one of the hard workers on the supply end of the conventions for many years, and it is pleasant to note that he is still in the ring, even though he has had so hard a jolt.

Gagambau is the name of the Filipino inferno. In accordance with early mythology, which once existed in a very advanced state, if we may trust the manuscript of Spanish writers, Gagambau was the place to which damned souls were sent to be tortured. So, if you happen to hear a man gently whispering to himself a word that sounds like this, it is not necessarily swearing. He is merely fixing in his mind one fact in Filipino history.

Talking about long-distance editing, the *Railroad Age Gazette* thought it was doing something in editing a daily paper at Atlantic City and printing it in New York; but the editors feel

like taking off their hats individually and collectively to Mr. Sellner, editor of the *Manila Times*, Manila, P. I., who was on Tuesday evening pounding out copy on their typewriter. Mr. Sellner varies his editorial duties by acting as manager and press agent of the Philippines Constabulary Band.

Frederick T. De Long, vice-president of the Chicago Railway Equipment Company, is the proud and happy possessor of a fearful and wonderful pair of chamois gloves. We take the liberty of suggesting that all those having an æsthetic temperament and a taste for the artistic visit the booth of the C. R. E. Company and take good notice of Mr. De Long with his gloved hand resting lightly on the gold brake-beams shown there, making a picture of exquisite harmony and beauty.

Frank H. Clark, general superintendent of motive power of the Burlington system and first vice-president of the Master Car Builders' Association, appeared upon the pier for the first time on Tuesday afternoon. Mr. Clark's well-deserved but nevertheless remarkably successful career is particularly interesting to the representatives of The Daily, for the reason that a part of his technical training and experience were acquired upon the *Railroad Gazette* during his connection with the late David L. Barnes.

According to the best obtainable official information, the following named gentlemen have been standing on their heads since arriving at Atlantic City: Messrs. S. Fred Atwater, Columbia Nut and Bolt Company; Fred W. Cook, American Locomotive Company; Geo. L. Lord, West Disinfecting Company; Clarke P. Pond, David Lupton Sons Company; J. F. Judd and L. M. Waite, National-Acme Manufacturing Company, and Geo. H. Musgrave, Starr Brass Manufacturing Company. It is also noticed that they have turned their respective hotels upside down. For further information see page 66 of Official List No. 2. But the editors have the sympathy which is said to come from companionship in misery.

The many convention friends of Edward P. Welles, of Charles H. Besly & Company, Chicago, will be pleased to know that since the conventions of last year Mr. Welles has been elected to the presidency of his company. His arrival at Atlantic City is expected Saturday or Sunday.

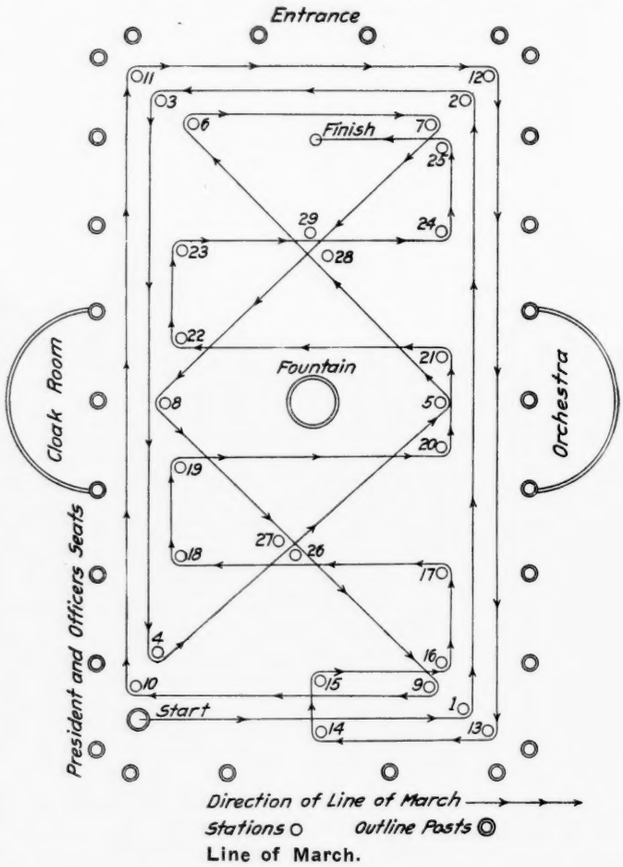
Mr. and Mrs. W. H. Miner, Chicago, arrived Tuesday and, as usual, are quartered at the Chalfonte.

Mr. and Mrs. Frederick A. Ingalls, of Chicago, accompanied by Miss Hammond, are at the Mariborough-Blenheim for their second M. M. and M. C. B. conventions. Mr. Ingalls is president of the American Locomotive Equipment Company, Chicago.

E. T. Hendee, of Joseph T. Ryerson & Son, Chicago, has the distinction of having traveled faster and further to reach the conventions—from the Pacific to the Atlantic—than probably any other man. After a four weeks' business trip in the West Mr. Hendee left Seattle Wednesday, June 9, arriving in Chicago just in time to have his correspondence handed to him and then catch the Pennsylvania M. M. and M. C. B. special, arriving in Atlantic City Tuesday evening.

THE MASTER MECHANICS' BALL.

The ball on Thursday evening was planned and carried on with mechanical accuracy. The grand march had been made a matter of special consideration, with complete specifications and blueprints. As related in The Daily on Friday morning, the lines of march and the position of the members of the floor committee who served a roller bearings at the turning points were accurately laid out upon a diagram of which each committeeman received a copy. It was something of a novelty to see a floor manager at a ball furtively studying a blueprint at such times as the line had moved away from his immediate vicinity. But the result showed the benefits of careful prearrangement. One of the onlookers who has been conspicuous in the association and on the ballroom floor for many years remarked that he had never seen a grand march carried through with so little confusion, and this though the number of people on the floor was far greater than ever before. J. Will Johnson, chairman of the Master Mechanics' ball committee, has some interesting figures concerning the attendance. Last year, at the Master Mechanics' ball, there were 283 couples,



Line of March.

or 566 people, in the grand march, the largest Master Mechanics' ball ever held. On Thursday evening there were 382 couples, or 764 people, in the grand march. The record of 1908 was therefore exceeded by 99 couples, or 198 people. Mr. Johnson also states that a greater number of people remained for the last dance (about 2 a. m.) than ever before.

THE WILSON DINNER.

A complimentary dinner to Hugh M. Wilson, one of the joint founders of The Daily, now published for its twenty-fourth year in honor of the conventions of the Master Mechanics' and Master Car Builders' associations, will be given this evening at 8 o'clock at the Hotel Chelsea. Until a year ago it was Mr. Wilson's constant initiative which caused The Daily to grow in interest and importance with each succeeding convention. It has been printed in many places, under many conditions of extraordinary difficulty, but he saw to it that the movement was always forward, year by year.

On his recent return from Europe a number of Wilson's many friends constituted themselves a committee of arrangements for a demonstration of appreciation of his long, unselfish and successful newspaper work in the interests of railways and manufacturers of railway supplies. It is intended that none of Mr. Wilson's friends be barred from the opportunity to participate in this demonstration, and although over 600 invitations have been issued it may be that some have been overlooked who ought to be present. It is therefore announced that the list of participants will be open until 11 o'clock to-day. The committee of arrangements is made up of the following: B. A. Hageman, Jr., Harry W. Frost, W. M. Simpson, Albert Waycott and J. Alexander Brown.

MASTER MECHANICS' ASSOCIATION.

Proceedings of the Third Session of the Forty-second Annual Convention.

President Vaughan called the meeting to order at 9.40 o'clock, and announced as the first order of business the report on tender trucks. H. T. Bentley (C. & N. W.) read the report.

Discussion on Tender Trucks.

The President—This is rather a serious subject on a good many roads, I think, and it seems to me it is one we could afford to discuss with the greatest freedom.

A long discusion followed, which it was finally decided will not be made public until the Executive Committee passes upon it.

The report of the Committee on Fuel Economies was read by Mr. Hayes.

Discussion on Fuel Economies.

D. R. MacBain (N. Y. C. & H. R.)—Mr. Hayes has had the bulk of the work to do, as I undestand, in getting up this report, and it is, in my opinion, one of the most important subjects that this association has had before it at the present time. The possibilities of economy in the consumption of fuel on almost any of the railways, including our own, are, of course, very great, and whether the fuel costs $1 a ton or $5 a ton, the time is coming when the big men in the motive power department will have to sit up and take notice of the saving of a cent. For that reason, I believe something should be done with this report, that this association should appoint another committee, or hold the present committee over, and give them a year longer to make further and more definite recommendations.

C. A. Seley (C., R. I. & P.)—I fully agree with the idea of the importance of this subject, and in connection with the report of the Committee on Lubrication believe that this association could wisely constitute a standing committee on each of these important subjects to keep the record up from year to year. I believe it would be well for us to have progress reports each year, and I would like to make the suggestion, perhaps not for action here, but to get the members thinking about the desirability of assigning these two important subjects to standing committees.

G. W. WILDIN,
Incoming President, Master Mechanics' Association.

Angus Sinclair—The greatest single item of expenditure on railways I believe to be that of fuel, and I do not know of any question that has been so loosely handled. Ever since I remember there has been pressure put upon the mechanical department to save fuel—do something, change your boilers, improve your boilers, improve your methods of combustion, and get more results out of your coal. The people who are responsible for the purchasing of the coal paid no attention whatever to the quality of the coal they were receiving. You had to pay as much for the poorest quality as you did for the best quality, and the consequence was that the tendency was to get the poor quality of coal. On one end of a division you would get a quality very different from what you received at the other end, with the result that you had to adjust draft appliances to suit the poorest quality of coal, and they were not adapted to the higher qualities of coal. I think the greatest reform necessary is some change in the method of purchasing a uniform quality of fuel, based on its steam heating properties. I notice that the Erie people have been paying a great deal of attention to that lately. They specified the coal to have a certain amount of heating properties. That is the right principle, and it ought to be followed more closely than it is by every railway in the country. That is the reform necessary. It is not greater heating surface, nor better methods of admitting air, nor anything of that sort in connection with the combustion. It is the fuel itself that needs to be reformed.

Robert Quayle (C. & N. W.)—I agree with what Mr. Sinclair has said. Now, we will suppose we have the fuel right and the specification is all right, the purchasing agent is all right and the delivery on the ground all right. I made this statement to 22 locomotive firemen within the last two weeks—that I could select 100 locomotive firemen on the Chicago & North Western, and I would guarantee that if I had every other man on the railway equally as good firemen as the hundred I could select, that I could save easily $500,000 a year in fuel. Now, then, if that be true it is a matter of education. It is first a matter of the man's fitness for the job he is filling. Second, it is the education of the man to get him up to that standard where he knows just when to put the scoop of coal into the firebox, and he knows just where to put it; then he knows all the conditions necessary to get the maximum result out of a pound of coal. If he knows all that, the most important thing to follow is to get him to do it, and that is where the railway men are up against it. The problem I have in mind is to get the men to do their best in line with the information they have. I know that when the road foreman of engines or the traveling fireman is on the engine the men do their work splendidly. They keep the decks clean and every pound of coal they handle is utilized in the firebox, and, as suggested in the paper, their pops are not open and they are not losing a quarter of a pound of coal per second of time the pop is open, but are utilizing the steam generated in the boiler for the engine. They secure the best results from the engine under those circumstances. If there is any man who can point me to the direction I should follow in my efforts to discover how you can get your men to do the best they can, I shall be glad to hear it. I believe there is nothing which you and I can do which will bring greater financial results to the treasury of the railways with which you and I are connected than to go after the fuel problem and the men who use it.

P. G. Baker (Panama)—On page 14 the committee points out the way to get the men to do the work, and that is the sixth proposition—full and fair accounting. That is all. Just give the men credit for the work they do and blame and punish them for what they do not do, and it will be done properly.

J. H. Setchel—I was much interested in this discussion, for the reason that it was a live subject 20 years ago. I had the honor then of being president of this association, and in my annual address I recommended, as a line in which there was the most economy that could be observed by the mechanical department, the proper consideration of the saving of fuel. A committee was appointed on fuel, and whether the committee has been standing or not, I think there has been a committee on fuel ever since. I believe that committee ought to be continued, for as one of the speakers has said, it is one of the largest items of expense in the motive power department, and it varies with every railway and with every kind of coal and with every variation of executive ability on the part of the officers of the railway company. I remember a number of years ago the lamented Forney, whom you all know, said in this convention that he would agree, speaking of the devices that were introduced from time to time for the improvement of the consumption of coal, that if he could get

the motive power men to pay close attention to the locomotive which he would provide, he could save 25 per cent. in fuel just as long as they would go according to his directions. He said: "All I will do is to paint the smokestack sky-blue, and that will do the work." Application is what we need. As Mr. Quayle very fully said, if we can get men to do what they know it is their duty to do, and continue doing that, then there will be a permanent saving in the consumption of fuel and it will increase from time to time as long as locomotives are run, but the trouble is you cannot keep men trained to do all the time a thing that they know to be right.

The committee stated that the officers should be responsible to the motive power department, and that, I believe, is the keystone to the whole situation. When an officer is working in one department and has no responsibility to another department, he does not care what the other fellow says. Very often the man is broad enough to look at all points of the question, and do what is right and best for all departments, but that is not always the case. The man who has the supervision of the fuel should be appointed by the motive power department, and that man should be responsible to the head of the motive power department, so that when you call him up and stand him up in a corner and question him as to what has been done, and what he knows ought to be done, and what he does not do, you will be in a better position to control him and secure the results which you are seeking.

John Tonge (M. & St. L.)—I do not think the machinery department is altogether to blame for the waste of coal. There is a train which in going a division will occupy 17 hours, we will say. The running time between the stations is 5½ hours, but through the incompetency of the despatcher to handle the trains properly the running time is increased very largely Should the locomotive be charged with the coal consumed during the other 11 hours? No. It seems to me that improper despatching has much effect on the waste of fuel. You men located in the East compile your figures before you start the train, and it gets there on time. I can tell you of railways in this eastern district where they do not pay a dollar for overtime of enginemen and crews. What do we pay? Now, then, it is in such conditions as this that we have to shoulder this waste caused by the despatcher who does not know his business.

Mr. Quayle—So far as the road I am connected with is concerned, the motive power department has all to say about the men on the engines, the motive power department has all to say as to how they shall handle them, the motive power department has all to say about the coal and how it shall be used. Notwithstanding that, notwithstanding it is up to the motive power department to get results, I suppose we have as much trouble as the other fellow does. The engineers and firemen have all kinds of excuses—did not get enough coal or had very poor coal, or had a hard run, or the engineer did not pump his engine right, or worked it down in the corner too far. You talk to the engineer, and he puts all the blame on the fireman. We are trying, as best we can, to get results, and we talk to the men very seriously about it. I have had men in my office to whom I have said somewhat as follows: "You are in a group of engines of which we have kept statistics, and it cost us so much for the fuel on your locomotive last year. I can afford to give you a thousand dollars a year and send you home, retire you. The road would make money if you were out of the service." We keep a tabulated record of all the men's supplies, his oil and his fuel account, and when we place the matter before the man in this form he begins to think pretty deeply. We then say to the man: "We will give you four months to improve, and if you are not as good as the average man on the road you will have to get out and make room for someone who will do the work properly." The man begins to take pride, and he says to the fireman, "The old man has a bad opinion of us, and you and I must work together to improve so that we can change his opinion." That is what we need. We need team work. The engineer and fireman should co-operate so well that every movement on the part of the engineer will be anticipated by the fireman, and everything the other man does will be anticipated by his mate. If they were to work together so that they would keep the proper amount of water in the boiler when climbing hills, that would be a factor in fuel economy; too much water is an enemy to the lubrication of the valves and cylinders, the water being carried through the throttle box into the dry pipe and into the valve chambers and cylinders, thus washing the oil away and increasing the friction and thereby requiring more steam to do the same work and more coal to generate the steam. When the men work together we get better results, but there is a tendency in the case of these men to get further apart and not take an interest in each other. These men are in their cabs together one-third of the time at least. If we could get those men to take an interest in each other and feel that each was the other's helper and each ought to bear the burdens of the other fellow, and get them to work together in such a way that they would enjoy their work, then we would get results. You and I, unless we have a pleasure in our work, will not get results, and neither will the fireman. If we can devise ways and means by which we will get these men together on common ground, so that they will help each other instead of warring against each other, and feel that this work they are doing is a real pleasure to them, then they will begin to work in the direction of getting economy and getting the largest possible results.

G. W. Wildin (N. Y., N. H. & H.)—I have been listening to what Mr. Quayle has said very attentively. I agree with him; he is right, but he has left out the third party, and that is the roundhouse foreman. There is a great amount of fuel wasted because of poor roundhouse practice, and we cannot lay it all to the engineer. About nine out of ten times the men put a split in the nozzle instead of caring for the base where it leaks, and they increase that split as long as they get steam. You cannot blame the fireman for that, nor the engineer. I find that about one-third of the carelessness is in the roundhouse and the other two-thirds is on the engine.

Mr. Quayle—The suggestion I might make there is the circular letter sent every 90 days to the master mechanic to give me the number of every locomotive, the size of the nozzle, or the split or tip in every nozzle, and tell me when it was put in and who put it there. That helps to fix that.

F. F. Gaines (C. of Ga.)—In line with what Mr. Quayle has just said, we have a practice that we think works out very nicely in that respect. We have every month the engineers' mileage, the coal burned, sizes of nozzle, and the whole arrangement. That is not only posted in the roundhouses, but the master mechanic has a copy and a copy comes to my office. If I find one condition on a certain type of engine using a small nozzle, we can go back, check up and find the reason. I think getting the size of the nozzles, not every 90 days, but every 30 days, and the arrangement and everything, is a good thing to do.

Mr. Wildin—My idea was to try to get the right feeling in the roundhouse man just as well as in the engineman, not the checking him up all the time and having to hang him every few days or weeks. We want to get him interested in the coal pile as well as the engineer and the fireman, so he will not put these splits in.

A. M. Waitt—It has been said that there have been for the past 20 years committees on the subject of fuel economy, which is true. There have been presented by the present committee some six proper essentials of fuel economy. This is a broad subject. On every one of these six essentials there is a great deal of difference of opinion. Would it not be wise for the committee to be continued, with instructions to take for next year one of those six essentials and thresh it out to a finish and present a report that the members could go home and put in practice—definite, well worked-out ideas? If they have done their work well, then another year take another of the subjects, and at the end of a certain reasonable length of time each one of those essentials that the committee have very properly mentioned would be well worked out and the members would have something very definite to work upon and put in force as the result of the best practice in the country. If it were in order I would move that the committee be continued with such instructions.

Mr. Brown—I am somewhat surprised at the manner in which this work is received. To my mind it is not received with the seriousness which the question justifies. There are many conditions affecting this. The roundhouse is equally responsible with the engine people. The selection of fuel is an important matter, and the question of tools is an important matter. What I had in mind was to make an amendment to Mr. Waitt's motion, that the committee be continued and also take up the question of engine supplies, fuel economy and construction of engine rules. Care in the roundhouse is so closely related that I feel it should be a part of the work of this committee.

D. R. McBain (N. Y. C.).—I do not agree with all the speakers, especially with Mr. Brown. I believe we should leave this fuel committee just as it is, a fuel committee. I do not believe we should add any more to what they have to do; and as a suggestion to bring about the results that Mr. Quayle has referred to as being possible, it would appear to me that on a railroad where $500,000 a year could be saved by a proper effort on the part of all the locomotive firemen and engineers, it would be well worthy of the time and attention of any railroad to go after half of that amount of money; and as a means of doing that, my suggestion would be that the railroad companies who are vitally interested in the matter of fuel economy appoint to take care of the firemen who do not know

the whole thing, a sufficient number of high class engine instructors to take care of probably 50 firemen, or 75 at the most. Confine that man's duty to the matter of saving fuel alone. It has been my experience that most of the men, whether they be of a high grade of intelligence or a low grade of intelligence, are willing to do that which is easiest to do, and I have always found that when I could show a man an easy way of doing a day's task, easier than the one he has been pursuing, he was willing to take hold. It seems to me, therefore, that the first step in the matter is to take care of the woful waste that we know is going on, appoint a sufficient number of instructors to take care of your men, have them give the necessary instructions from week to week, if not from day to day, and do not load the special men down with other duties which are largely post-mortem, and which is the practice on most railways to-day, sending a traveling fireman off to look for something that is weeks old. Let him attend to his duties as instructor of firemen and I guarantee that the results will be amazing.

C. A. Seley (C., R. I. & P.)—The theory of the executive committee in proposing these subjects was that of a progress report, and while, no doubt, these branches of the particular subject under discussion could be enlarged upon, or taken up serially one by one and threshed out to a certain amount of conclusion—I don't mean the end of it, I believe that if the committee could be continued, or made a standing committee, they should do what is stated here in their opening paragraph, give the progress of the art from year to year. We are meeting all the time. Not only by actual designs, but by methods of instruction, and all of those matters that have been spoken of, particularly by Mr. Quayle and Mr. McBain, those are matters coming properly within the progress report from year to year. Suppose some railroad gets out a method such as Mr. McBain has outlined. Let us have the results of such a method as that, and so on from year to year let us gather into this association the latest knowledge, the accumulation of the year, as to the progress in fuel; and I make the same suggestion with regard to lubrication.

The President—Mr. Waitt's motion is before the house, that the committee be continued and requested to take up in more detail and report recommendations on one of the six essentials which they consider the most important as bearing upon fuel economy.

The motion was lost.

The report on lubricating economies was presented by G. J. DeVilbiss (H. V.), of the committee.

Discussion on Lubricating Economies.

C. A. Seley (C., R. I. & P.)—I think that this report is also of value, as I stated with reference to the previous report, as a basis for a matter of progress. There is just one matter I would like to speak of in discussion of this report, and that is that undue importance is often given lubricating economies as compared with fuel economies, losing sight of the cold dollars and cents proposition. In reporting the performance of superheater engines, the superheater undoubtedly takes more oil, and unless that oil is stated in dollars and cents, instead of pints, it gives undue importance to the extra amount of oil consumed.

H. T. Bentley (C. & N. W.)—I move that the committee be continued for further report. (Motion carried.)

The Chairman—The next order of business is an individual paper entitled "Transfer of Heat," by Prof. Charles E. Lucke. As the writer of the paper is not here, and it is purely a technical paper, if there is no objection it will be received and printed in the Proceedings.

The next order of business is the report of the Committee on Revision of Constitution and By-Laws.

D. F. Crawford (Penn. Lines), chairman of the committee, read the report.

The President—In accordance with our constitution, the constitution and by-laws can be amended in accordance with this report by a vote of the members present.

Mr. Crawford—I would say for the information of members that this circular was sent out in December as well as being presented here to-day.

Mr. Quayle—I move that the constitution be amended in accordance with the report of the committee; that the report of the committee on revision of constitution and by-laws be adopted by this association, and that the constitution and by-laws be revised as recommended by this committee.

The motion was carried.

The President—The next order of business is the report of the committee on subjects.

Mr. Quayle presented the report.

The Secretary—Mr. Quayle wrote me under date of May 20 as follows: "When our committee report is presented to the executive committee for their consideration I would offer the following subject for their consideration as a matter for committee work: Frame Construction for Engines with Outside Valve Gear. This subject was suggested to the committee after their report was forwarded to you, but I believe it is a subject worthy of some consideration."

That will simply be taken as a part of the report of the committee on subjects.

Mr. Crawford—I move that the report of the Committee on Subjects be referred to the incoming Executive Committee for consideration. (Carried.)

The President—The next order of business is the presentation of the report on Resolutions, Correspondence, etc.

G. M. Basford presented the report, and it was adopted as the sense of the convention.

The secretary read the report of the Auditing Committee, stating that they had examined the accounts of the secretary and treasurer and found them correct.

The report of the Committee on the Bill for Federal Boiler Inspection, which was presented to the United States Senate, was read by by D. F. Crawford (Pennsylvania Lines), chairman of the committee, and the recommendation which it contained was adopted.

The report of the Committee on Recommendations contained in the president's address was read by L. G. Parish and its recommendations adopted.

Officers for the ensuing year were elected as follows: President, G. W. Wildin, N. Y., N. H. & H.; first vice-president, C. E. Fuller, Union Pacific; second vice-president, H. T. Bentley, C. & N. W.; third vice-president, D. F. Crawford, Pennsylvania Lines; treasurer, Angus Sinclair, Railway and Locomotive Engineering. Members of the Executive Committee—C. A. Seley, C., R. I. & P. (two years), D. R. MacBain, N. Y. C. & H. R. (two years), and F. M. Whyte, N. Y. C. & H. R. (one year).

President Vaughan—This concludes the business arranged for by the pragramme, but before surrendering the position of president of this association to my illustrious successor I wish to thank the Executive Committee for the ability with which they have assisted in conducting the work of the association; the members of the committees for the work they have done in preparing reports and papers; and the members of the association for the help they have given me in this work. Gentlemen, I will ask that the same assistance and help be given to my successor, Mr. Wildin, to whom I have great pleasure in resigning the chair.

President-elect Wildin—I wish to express my high appreciation of the honor which you have conferred upon me to-day. My appreciation is such that I cannot express it in words, but I sincerely hope when the time comes for me to turn the gavel over to my successor you will at least all feel that I have made an honest effort to maintain the high standing set by many illustrious past presidents of the association. Again thanking you, I wish you a prosperous year.

C. E. Fuller—I offer a vote of thanks to our retiring president, Mr. Vaughan, for his energy and ability, shown in his office of President—his untiring work and efforts, which have enabled us all to enjoy fully one of the most successful conventions that it has been my pleasure to attend. I feel that there have not been many presidents who have been as thoughtful and have had the ability to not only handle the meetings of this association, but to manage a menagerie and side show, that has been appreciated by a great many of our members. Our president has been ably assisted by our secretary, who was able to round up the force and bring them in without saying a word or disturbing the meeting.

President Wildin—Gentlemen, I notice at my left Mr. Turner, the president of the Railway Supply Men's Association, who whispered to me that he had something to bring before this convention, a duty which it will be a pleasure for him to perform.

Mr. Turner—I take great pleasure in introducing George A. Post, who has been requested to represent the Supply Men's Association in your closing exercises.

George A. Post—A delightful and highly-prized honor has been conferred upon me by Mr. Turner. At his behest I appear before you charged with a commission in the performance of which I will detain you but a few moments. Mr. Vaughan, this is a very happy moment for me, and it is a justly proud one for you, as we face this assembly of distinguished railway officials over whom you have presided so ably and acceptably during the past year; my heart beats exultantly as I recall the thrilling story of your brilliant achievements since first we met. In striking contrast with the picture that hangs upon the wall of my memory compared with the present exalted station you enjoy, is that of the young man bending over the drawing board in the office of Mr. Pattee, of the Great Northern up in St. Paul, some 15 years ago. It has been with intense pleasure that I have seen you swiftly and surely ascend the heights that are only attained by men

possessed of pluck and brains. It is not by accident that men become president of the American Railway Master Mechanics' Association. It is a distinction conferred by men qualified to discern and to reward merit. It is a prominence to be coveted. It is a goal, sir, that you have reached by sturdy persevering strides.

This badge (exhibiting President's badge) is a prize that is well worth having, and that it is my pleasure to present it to you is tinged with a delicious romance that gives me great joy. I fear that I have completely reversed the familiar story of John Alden and Priscilla, in that I have spoken too much of my own feelings at this moment rather than those who sent me here to speak for them. To convey to you the congratulations and the best wishes of a legion of friends and admirers was my mission. I trust, Mr. Vaughan, that you will accept delivery and make no note of the delay in transmission. Just say that you received it post haste.

Mr. Vaughan—Mr. Post, it is impossible for me to adequately thank you for the presentation you have made and the kindliness and friendliness you have shown. I can only say I shall always look upon this badge as a memento of the great good fortune I have enjoyed in being president of the American Railway Master Mechanics' Association, an honor which I shall always regard as the highest which I ever could have hoped for and the greatest honor in my career. When such an honor is accompanied by expressions of kindliness and friendliness from friends whom I have known as long as I have known you, Mr. Post, it is made doubly pleasant and I thank you from the bottom of my heart.

Adjourned.

Topical Discussions.

J. F. Walsh, C. & O. Ry., at the Master Mechanics' Convention, June, 1909:

Brick arches and water tubes in locomotive fireboxes.

J. F. Walsh (C. & O.)—Not considering for the moment the many desirable features in the use of the brick arch in locomotive fireboxes, we will consider only water tubes, which are applied primarily for the purpose of carrying the arch bricks.

In the four 3-in. water tubes which are used in the fireboxes of our locomotives we have a total heating surface of about 26 sq. ft., which aids materially the steaming qualities of the engine, if considered alone.

Again, in the wide firebox locomotives, with a grate surface of practically 50 sq. ft., the rapid deterioration of side sheets has been the cause of complaint, due to the buckling and cracking of those sheets at a point close to the flue sheet and crown sheet.

With a total of 250 of that type of engine in service, some of them in service for the past six years, we have had little cause for complaint concerning defects in our side sheets as noted above. This we believe is due to the fact that our arch tubes assist very materially in the circulation of the water, and by that means avoid the overheating of the side sheets.

Therefore I believe that the arch tube itself, independent of any other feature connected with it, is a desirable addition. We provide ample means for keeping the tubes clean by placing hand hold plates in the boiler head, and in the throat sheet in front of the water tube openings. These are taken off each time the boiler is washed and the tubes are thoroughly cleaned.

As to the usefulness of the brick arches, in a test recently made on one of our divisions we proved that by the use of the brick arch we can save 20 pounds of coal per mile as compared with the operation of the engines without the brick arch.

Where the brick arch is used the locomotives steam much more freely than without the brick arch, and we are enabled to keep up full boiler pressure regularly.

The use of the brick arch enables the fireman to maintain the maximum boiler pressure regularly. Without the brick arch this cannot be done when the engines are worked to full capacity. Therefore, without the brick arch we cannot haul full tonnage; so by the use of the brick arch we increase the earning capacity of the locomotives and of the railway.

Our brick arches cost us on an average 30 cents per brick. Using 10 bricks in each engine means a total cost per engine for arch brick of about $3.

A saving of 20 pounds of coal per mile will mean a saving of 2,000 lbs. of coal per 100 miles, and with coal costing us approximately $1.50 per ton we can save the price of the brick arch in a round trip by the saving in coal, and not considering the increased efficiency of the engine.

It would seem quite superfluous to add that by the use of the brick arch we obtain very much better combustion of smoke gases and reduce the quantity of smoke emitted. The same is quite true of the quality of sparks emitted, as the brick arch serves as a baffle to the escape of the cinders, retaining them in the firebox until consumed. This results in better firebox efficiency, reducing also the danger from fires along the right of way.

Our transportation officials and our enginemen and firemen complain if our supply of arch brick becomes exhausted, or if for other reasons we have to operate our engines without arch brick.

Dependent on the quality of the brick and the frequency that it has to be removed for flue or other repairs, a set of brick in our heavy locomotives will last from two to six weeks. Where the quality of the brick is good it may be removed to permit of work being done and used again several times.

Prof. H. Wade Hibbard (Univ. of Mo.)—In connection with fire brick arches in locomotives, some information that I gained last summer when I was connected with a railway making very extensive use of fire brick arches may be of value to this association, and that is, with regard to the durability of the firebrick. I believe that sufficient attention has not been paid to the sort of firebrick which should be used for this purpose. Fire brick for locomotives should have a greater degree of toughness and less ability to stand high temperature. The temperature in a locomotive firebox is low as compared to the temperature in an open-hearth steel furnace for the manufacture of open-hearth steel, and if you desire to have fire brick which will stand mechanical abuse in a locomotive firebox, then you should get the tough fire brick rather than the high temperature fire brick.

George L. Fowler (Railroad Age Gazette)—I think it would be interesting if some members of the association would give data as to what results they are geting where they have poor water and bad coal. Mr. Walsh's road, as I understand it, is remarkably blessed in two particulars. They have wonderfully pure water and a superb quality of coal. Now, it is quite possible that entirely different results might be obtained where you have a bad scaling water in use. It would be very interesting to have some data in that particular.

The President—Our experience has been like most roads, I think, that it is largely a question of local conditions. We use brick arches in some districts and we find their use inadvisable in others. There is very little doubt about the saving of coal, but the question is whether the trouble makes it a paying proposition. I think the Lake Shore has been doing a great deal of work on brick arches lately, have you not, Mr. Parish?

LeGrand Parish, Lake Shore—We have practically all the engines on the Lake Shore equipped with brick arches, including switch engines. About two years ago in looking into the subject we found that we had perhaps 100 engines maintaining the fire brick and we had to fight every minute to maintain that in the 100 engines, on account of the difficulty we had in the engine houses. There was also one other difficulty which we overcame. The great trouble in maintaining the arch brick in locomotives has been on account of the fact that we all used a brick that was too long. They were broken in shipping, they were broken in handling in the engine house, and they were broken when they were removed, and all that sort of thing. We got entirely out of fire brick. I was having all kinds of trouble on account of the engines not steaming. We use a lot of old brick that we had on hand which we considered obsolete, and the men who had this work in charge, our supervisor of boilers, and supervisor of locomotive machinery, were told for heaven's sake to use that brick in some way so that they would have brick arches in the engines. The result was they designed a short brick which rested in between the arch tubes, and it more than doubled the life of our brick and got us practically out of all our troubles. The result of that experiment has been that we have equipped everything on the Lake Shore with arch brick, and the saving in cost of coal is something enormous. I cannot give you the figures, I am sorry I haven't got them. It has made a wonderful difference in our coal—that in connection perhaps 75 other things, a number of which were mentioned in a previous paper.

A. E. Manchester (C., M. & St. P.)—It has been the practice of the C., M. & St. P. for 20 years to use arch brick. We are so thoroughly and firmly convinced of the good of the arch brick, and our men are in the same position, and feel that they could hardly run the engines without it. Whenever a condition arises that on account of the shortage of stock or something of the kind the arch bricks are not maintained, reports are always coming in that the engines are not steaming, etc., and that is given as the cause. We believe that a great deal of good is done with the brick, and we get just as good results, if not better, in the bad water districts as we do in the good water districts.

Topical Discussion.

"Is previous railway experience of advantage to locomotive firemen?"

D. R. McBain (N. Y. C.)—This question is one that we believe worthy of debate, as there are many angles from which the matter ought to be viewed.

Ordinarily, there are very few applications from the ranks of the shopmen, the trainmen, the switchmen or the clerical

force for positions as firemen, and it has been our experience that, in most cases where applications are received from these sources, the applicants have not been successful for one reason or another, and turn to the locomotive service as a last resort.

From the ranks of the section men, the bridge gangs, the car repair gangs and the freight house gangs, there are many very desirable applicants. These men, as a whole, are used to rough heavy work at low wages, and they appreciate fully the advantages afforded by the locomotive service in the matter of better working conditions and increased remuneration.

While it has been our experience that not all of these men make good as locomotive men, the exceptions are, perhaps, less in proportion to number than of any other class of men hired, and some of the very best engineers in the service at the present time are men who began on the track, the repair yard, the bridge gang or the freight-house gang. In such cases, by reason of the fact that they, in most instances, do appreciate that the locomotive service is more desirable in all respects than the jobs they left, it would seem their previous experience was advantageous to themselves and the company alike.

Viewing the matter from a standpoint of the practical railway experience of such men, they, of course, cannot be classed with applicants who have had previous experience as trainmen or switchmen, especially when firemen are needed to keep the road open, but it has been our experience that the latter men will not remain in the locomotive service longer than is necessary to find a job in the service they came from.

To sum up:

1. Should it be the good fortune of a road to get men who have fired elsewhere and been laid off on account of reduction in force, the experience they have had ought to be of some value to the employing company. They have, as a rule, the advantage of being young men, which is a desirable feature.
2. If intelligent young men could be induced to enter the track, bridge, car repair and freight house gangs with a prospect of advancement to the locomotive service, if they can qualify, it would seem that the scheme ought to work out advantageously to the railway companies.
3. In our opinion the next best material from which to choose firemen is from the farm. The farmer's son, after he is broken in, is usually appreciative of his position and will develop into a good, reliable locomotive fireman.

Much can be accomplished toward improving efficiency among locomotive firemen by having good men as firemen's instructors who shall have no other duties to perform and who can apply their whole mental and physical energy toward instruction.

RESOLUTIONS.*

Whereas, the forty-second convention of this association has been even better attended and more successful than that of last year and the gratitude of the association is due to those who have contributed to this result, be it therefore

Resolved, That the appreciative thanks of the association be extended to the president for his able, inspiring address, the officers of the association, especially the secretary, for the painstaking preparations for the convention and conscientious attention to every detail in the conduct of the sessions; to the committees and authors of papers in general for the preparation of reports and papers, and especially to Dr. W. F. M. Goss for his exceedingly valuable paper upon locomotive superheating; to the committee of arrangements for its effective service in providing so admirably for the meetings; to the railways for courtesies extended; to the hotel and business men of Atlantic City for their hospitality; to the Railway Supply Manufacturers' Association for the most comprehensive and most attractive exhibits they have even shown; to the technical press generally, and to the *Railroad Age Gazette* especially, for prompt reports of the discussions.

The Independent Pneumatic Tool Company, manufacturers of the "Thor" pneumatic tools, is represented at the convention by James B. Brady, W. O. Jacquette, John D. Hurley, Geo. A. Gallinger, R. S. Cooper, John P. Bourke, Ross Watson and R. T. Scott.

*Report presented at the annual convention of the American Railway Master Mechanics' Association. Committee: G. M. Basford, C. A. Seley, L. G. Parish.

Conventionalities

(For additional "Conventionalities" see page 1373.)

A. C. Morse, general manager of the Ohio Seamless Tube Company, and formerly general superintendent of the seamless mills of the National Tube Company, stopped off at the convention Friday on his way to Shelby.

The many friends of Mrs. Edward Grafstrom, widow of the late Edward Grafstrom, of the Santa Fe, who lost his life in the brave rescue of other lives in the Topeka flood of some years ago, will be pleased to learn that Mrs. Grafstrom is in good health and is now enjoying a visit with Mr. and Mrs. J. F. Dunn, of Salt Lake City. It will be remembered that shortly after Mr. Grafstrom's lamentable death a fund was created by the railway and railway supply friends of the deceased. This fund was wisely invested, with the result that Mrs. Grafstrom is living in comfort.

The Entertainment Committee, at considerable expense and trouble, has provided a partial eclipse of the sun for the exclusive entertainment of convention people. It is not yet definitely determined by the committee on what day or at what hour it will be best to arrange for the event, but most likely it will be set for some evening when there is not much doing. Admission will be by badge only.

The absence this year of H. J. Small, San Francisco, general superintendent of motive power of the Southern Pacific, is greatly regretted by all. Mr. Small has lately been operated on at the Johns Hopkins Hospital, Baltimore. The operation was very successful and Mr. Small has now resumed his work.

J. H. McConnell, one of the leading mechanical railway men at the conventions in past years, will not be here this year. He has lately bought a home in Los Angeles, Cal., where he has mining and other interests. It will be good news to know that Mr. McConnell is again in good health.

The finishing touches were added to one of the most interesting exhibits on the pier—that of the Carborundum Company—where "Cheyenne Charley" Schumaker arrived from the West and joined the bunch of delegates representing his company here at the convention. Everybody was glad to see "Charley" and listen to his exaggerations on sage-brush philosophy, jack rabbits and the big sales being made in the Golden West. But when it comes to fabricating on the volume of business being done, "Cheyenne Charley" has to go some to beat friend Charlie Nicholson, that bald-headed patriarch of the Carborundum Company, who addresses his mail to the office: "Dear House—Enclosed find fifty orders—if you can." The Carborundum Company is represented at the convention by five delegates, one of whom may always be seen at the social functions, as they have a dress suit among them. It was Grindstone Bill Sanderson's turn to wear it at the M. M. grand ball. Grindstone says that as he has been changed from representing his company in the South to the city of Pittsburg he hopes soon to become an alderman, so that next year he will have a suit of dress clothes of his own. We regret that although our representative called several times at the booth of the Carborundum Company, he was unable to have a good interview with their Mr. Rayner or Mr. Fuller. Evidently the erstwhile attractions of the Boardwalk were too great for these two staid gentlemen.

"Who is this that cometh from"—somewhere or other—"and in dyed garments from Bosrah?" This question is said to have been asked some thousands of years ago. Certainly not John Chamberlin. His garments on Friday had not been defiled by dye-stuffs; no, not from the crown of his hat to the soles of his shoes. If he could only recover the long-lost umbrella and re-cover it in white after it was recovered, John

would be a peach. Not any dyed garments from Bosrah nor anywhere else for him.

A feature not down on the program of the Master Mechanics' Association speaks for itself, and in order that it may have the widest possible publicity the facts are given in full, as follows:

A Challenge.

"*To Whom It May Concern.*"

And especially the American Railway Master Mechanics' Association, now in annual session at Atlantic City, N. J., June 16th to 18th, 1909:

The builders of the modern type of locomotive, the world over, do not know the first principles of correct mechanics in their construction, judging of such knowledge by their product in a locomotive. I say this in the words and spirit of Lincoln's Second Inaugural, with malice towards none, with charity for all, as God gives us to see the right.

The writer assumes the full responsibility of this statement, and adds: This accounts in large measure for the awful railway slaughter, due to either *willful neglect or cumulative ignorance.* (See United States Inter-State Railway Commission reports.)

WILLIAM E. LOCKWOOD, L. M. E.

St. Clare, Atlantic City, N. J., or Loch-Ærie, Glen Loch P. O., Pa.

Late advices indicate that the convention company will be swelled this morning by a company from Boston in charge of J. A. Droege, superintendent New York, New Haven & Hartford at Providence, R. I. The party will include, in addition to Mr. Droege, Mrs. Droege and son, A. Ross, superintendent New York, New Haven & Hartford; P. Morrison, Boston & Albany, and Mrs. Morrison; W. Merritt, Boston & Maine, and sister; G. H. Folger, assistant general superintendent Boston & Maine; W. M. Sanborn, division superintendent Boston & Maine; W. K. Hallett, superintendent Bangor & Aroostook; F. A. Lawton, superintendent Sandy River & Rangeley Lakes, and Mrs. Lawton; H. E. Morrell, superintendent Monson, and Mrs. Morrell; W. A. Waterbury, retired superintendent, New York, New Haven & Hartford; C. N. Woodward and C. S. Lake, division superintendents New York, New Haven & Hartford.

Secretary Taylor advises that he will be at the registration booth Saturday forenoon and Sunday forenoon to register the members of the Master Car Builders' Association. The members of the Master Car Builders' Association who are now in Atlantic City should register at once in order to avoid the rush Monday morning.

Lost—Enrolment committee badge No. 2076. Finder will please return to James G. Mowry, at the enrolment booth.

F. E. Miner, shop manager of the Grip Nut Company, Chicago, is being initiated into the convention life by four "old boys." The crowd is at the Dennis, a precautionary measure against losing the pier.

The man who was referred to the other day as Porthlewaite was really Postlethwaite. You know Postlethwaite, of the Pressed Steel Car Company? The printer lisps a little.

The many friends of Charles A. Lindström, of the Pressed Steel Car Company, were wondering why it was that he was looking so glum soon after his arrival at Atlantic City. It all came out, however, when they saw the glow in his face at the arrival of his two daughters, Charlotta and Jeannette. All three are stopping at Chalfonte.

Horace Bowman, of the Link Belt Company, Nicetown, Pa., left Atlantic City on Thursday, but will return to-day. Laurence Spillan and H. D. Mitchell will be in attendance throughout the conventions, and Howard Burkholder will be on hand part of the time.

F. W. Sargent, chief engineer of the American Brake Shoe Company, has been seen wandering around in a semi-dazed way during the week of the Master Mechanics convention. It has been a question among some of those who know him best whether this condition is due to poring over some square yards of figures that he carries in his pocket, or whether he has lost his coefficient of friction.

E. R. Hibbard, the genial president of the Grip Nut Company, Chicago, is the greatest story teller that ever frequented "Old Vienna." He was in action there the other evening, and his stories are still going the rounds at the conventions.

J. Snowden Bell, general counsel for the American Locomotive Company, the Westinghouse Air Brake Company and other firms, is again visiting the convention. He is stopping at the St. Charles.

In connection with the topical discussion on the subject, "Is the usual front row of crown bolts in a locomotive boiler beneficial or otherwise?" reported in The Daily on Friday morning, C. A. Seley, who opened the discussion, desires to call particular attention to the fact that the work for which he received the credit was done by one of the boys in his office, who presented the arguments on both sides. The question was thus put in the best shape for further consideration, and Mr. Seley desires that credit be given where it is due.

A late report from the wireless station announces that a very interesting exhibit will arrive on Sunday morning, via the water route. The reason for this is the extraordinary weight of the exhibit, railways having declined to haul it, fearing damage to their bridges. The coal barges and one part of the exhibit are equipped with a packing that is highly recommended by the exhibitors. Contrary to the rules, this exhibit will be moved upon the pier during the day for the reason that it cannot be found after dark. Railway men and others should make every effort to see this exhibit, which is known as the two "Jims" without the "jams." Please omit flowers.

The district meetings for the election of members to fill vacancies in the executive committee were held in the Greek Temple on the pier on Friday afternoon, the meetings for the different districts taking place at half hour intervals from 2.30 to 4.30. The results of the election were as follows:

First district, New England states, Alfred C. Ashton, Ashton Valve Company, Boston, Mass.

Second district, New York and New Jersey, Charles P. Storrs, Storrs Mica Company, Owego, N. Y.

Third district, Pennsylvania, Delaware, District of Columbia and West Virginia, B. E. D. Stafford, Flannery Bolt Company, Pittsburgh, Pa.

Fourth district, Ohio, Indiana, Michigan, Kentucky and Tennessee, A. D. McAdam, Damascus Brake Beam Company, Detroit, Mich.

Seventh district, states west of the Mississippi valley, including Louisiana and excepting Iowa and Minnesota.

There is no change in the membership for the fifth and sixth districts.

PURDUE DINNER TO-NIGHT.

The Purdue Railroad Association will hold its annual convention dinner in the rose garden of the Shelburne to-night. Some twenty members have signified their intention of attending and an enthusiastic evening will be spent. All are requested to be on hand at 7 p.m.

TO-DAY'S PROGRAM.

The annual meeting of the Railway Supply Manufacturers' Association will be held in Convention Hall of the pier on Saturday, June 19, at 11 a. m. Time and place of district meetings for the election of Executive Committee members will be announced in the Daily *Railroad Age Gazette.*

ENTERTAINMENTS.

10.30 a.m.—Orchestra concert, Entrance Hall, New Pier.

2 p.m.—Baseball parade from New Pier to special trolley cars.

3 p.m.—Baseball game, Master Mechanics and Master Car Builders vs. Supply Men, Pennsylvania Railroad Co.'s Inlet Park Baseball Grounds.

8.30 p.m.—Band concert, New Pier.

9 p.m.—Euchre party for convention ladies, ball room, Marlboro-Blenheim Hotel.

ANNUAL BALL GAME.

The baseball game between the railway men and the supply men will be called at 3 o'clock this afternoon at the Pennsylvania Railroad's Inlet Park baseball ground. The baseball parade to the special trolley cars will start from the Million Dollar Pier at 2 o'clock. The line-up of the teams is as follows:

Railway Men.

First Base—G. W. Wildin, captain, New York, New Haven & Hartford.
Catcher—H. C. Oviatt, New York, New Haven & Hartford.
Right Field—G. W. Clancy, New York, New Haven & Hartford.
Short Stop—A. Lamar, Pennsylvania.
Second Base—H. E. Passmore, Toledo & Ohio Central.
Left Field—T. H. Goodnow, Lake Shore & Michigan Southern.
Third Base—E. I. Dodds, Erie.
Pitcher—T. P. Hinckley, Cincinnati, Hamilton & Dayton.
Center Field—H. V. McKedy, New York, New Haven & Hartford.
Substitutes—I. S. Downing, Lake Shore & Michigan Southern; R. B. Rasbridge, Philadelphia & Reading; L. P. Sharpe, Armour Car Lines.

Supply Men.

Third Base—F. H. Coolidge, American Brake Shoe & Foundry Company.
Center Field—Harry Vissering, Charles R. Long, Jr., Company.
Short Stop—G. A. Barden, Chicago Pneumatic Tool Company.
Left Field—E. A. Johnston, Duff Manufacturing Company.
Right Field—C. F. Elliott, Acme White Lead & Color Works.
Pitcher—G. T. Chandler, Sterling Steel Foundry Company.
Catcher—W. H. Allen, Charles H. Besly & Co.
First Base—S. M. Hildreth, H. W. Johns-Manville Company.
Second Base—F. M. Nellis, Westinghouse Air Brake Company.
Substitutes—L. J. Hibbard, H. W. Johns-Manville Company; S. W. Midgley, Curtain Supply Company; George Gallinger, Independent Pneumatic Tool Company; Frank Martin, Jenkins Brothers; George Groobey, Buckeye Steel Castings Company.
Umpire—T. F. Barton, Delaware, Lackawanna & Western.

SUPPLY MANUFACTURERS' MEETING.

Attention is again called to the annual meeting of the Railway Supply Manufacturers' Association, which will be held in the Greek Temple at 11 a.m. to-day (Saturday). It is important that all who are concerned in the affairs of the association should be present.

According to figures submitted by O. M. Edwards, it is just 970 miles from Syracuse, N. Y., to Atlantic City, and his speedometer backs him up. The party left home Friday afternoon, June 11, reaching Albany that night. Saturday they went to Pittsfield, Mass., and made some side trips through the Berkshires. They spent Sunday night in Hartford, ran to New York the next day, and came here Tuesday. They report no trouble with tires, platforms or window fixtures. They plan to return via Philadelphia. The party consists of Mr. and Mrs. O. M. Edwards, Joseph J. Edwards and Eleazer W. Edwards, 2nd.

B. S. McClellan, "Smiling Mac," of the Grip Nut Company, Chicago, is an old railway man and he sure does know a grip nut when he sees it; in fact, it is said that he "eats 'em alive."

Herbert Green, vice-president of the Grip Nut Company, Chicago, who was recently married, hurried back from California to attend the conventions. Mr. Green has gained immensely in weight, thanks to a good rest in California surroundings. He is not as "green" as he looks, especially if you get him on the proper subject, grip nuts.

Arthur Haller, of the American Locomotive Company, will shake hands, but he has nothing to say. He is afraid that it will get into the DAILY RAILROAD AGE GAZETTE. He knows what a "chiel amang ye takin' notes" is capable of, because he is in the publicity line himself.

Billy McGowan made his appearance on the pier early in the morning following the M. M. ball looking in the pink of condition; but it was clearly evident that he is not a past master in the art of applying cosmetics. The pink was all in one spot—on the left lapel of his coat.

All regret the absence this year of Andrew J. Farley, of Chicago. It is Mr. Farley's first skip in many a year, and it is to be hoped it will not occur again. The genial gentleman has built a beautiful country home at Wheaton, Ill., and declares his only aspirations are to remain a plain farmer and to become in time the Luther Burbank of the cabbage and potato world.

W. White, president of the National Boiler Washing Company, is spending most of his time answering questions regarding the absence of Mrs. White. This is the first convention Mrs. White has missed in nine years, and her friends feel the loss of her pleasant and cordial greetings. Her absence is due to the graduation of her daughter, Genevieve.

C. H. Tobias, treasurer of the Union Draft Gear Company, Chicago, accompanied by Mrs. Tobias, is stopping at the Traymore. This is Mrs. Tobias' first attendance upon the convention, and her pleasure in the experience is shared by those who have had the opportunity of forming her acquaintance.

Wm. D. Thompson, of the Hutchins Car Roofing Company, Detroit, is at the Traymore, accompanied by Mrs. Thompson. This is Mrs. Thompson's first visit, and the experience has all the charms that novelty can give.

E. M. Roberts, who was formerly a regular attendant upon the conventions of the Master Mechanics' Association, but who has not been present for several years, is present this year. He is particularly interested in the subject of fuel economy, to which he has given special attention.

The Garlock Packing Co., Palmyra, N. Y., wishes to go on record as indorsing the rule prohibiting the distribution of souvenirs, as its representatives can now devote more time to explaining and demonstrating the superior merits of Garlock packings, which are extensively exhibited at booth 420.

* * *

In booth 17 the Mason Regulator Company, Boston, Mass., is exhibiting its latest design improved type of locomotive reducing valve, which embodies the established principles of stationary practice in reducing valves for railway car heating. There is no "huddling" of the steam, as frequently occurs in the ordinary form of steam-heat valves, causing the pressure gage on the heating line to vibrate excessively. This valve is designed to permit only the required flow of steam, and to be used to replace large valves which can be set only partly open, resulting in wire-drawing and consequent damage to the joints. These valves, which have successfully passed severe tests, are designed after twenty-five years of experience in this line of work.

Conspicuous among the other Dickinson devices is the Dickinson cast iron caboose jacks, which are endorsed by all who have used them. They take the place of the troublesome and expensive sheet iron jack and embody several unique and desirable features prominent among which are ease and cheapness in application, ventilator at roof line, absolutely fireproof and indestructibility and durability. These features are self-evident, as seen by inspection at the booth of Paul Dickinson, Inc., Chicago.

* * *

The large variety in design and construction which modern railroading requires in smoke jacks is well illustrated at the booth of Paul Dickinson, Inc., Chicago. Efficient roundhouse ventilation has made rapid strides in recent years, presenting problems which have been successfully solved by this company.

* * *

The newest thing in gents' millinery may be seen at the booth of the Carborundum Company, Niagara Falls, N. Y. Ask for the grindstone peddlers, "It beats the Devil."

* * *

The Wickes Boiler Company, Saginaw, Mich., is taking great interest in the conventions, and although this is its first year as an exhibitor in the supply ranks, it is hoped it will not be the last. In space 363 there is being shown a handsome working glass model of a Wickes vertical water tube safety steam boiler. The interests of the Wickes Company are well handled by Lewis Beebee, Saginaw, Mich.; C. F. Wilson, Chicago, and Charles P. Pollak, New York.

* * *

The Ward Equipment Company is showing the new low-pressure heating equipment now being made and sold by that company. This device, which insures an agreeable temperature in the cars at all times, is automatic, simple and inexpensive. It has been very favorably commended by many who have visited the booth exhibit. The Ward car ventilator, as well as the storage battery charging plug and other well-known Ward devices for use with car heating apparatus are also shown.

CARDWELL TESTING MACHINE.

The members of the American Railway Master Mechanics and Master Car Builders' associations are most cordially invited to visit the exhibit of the Union Draft Gear Company on Saturday morning at ten o'clock and witness draft rigging tests on the Cardwell testing machine. The little testing machine which has been designed by J. R. Cardwell is most interesting in itself; but the results which it shows regarding the Cardwell draft gear is still more interesting. The Union Draft Gear Company and the Cardwell Manufacturing Company exhibits are in booth numbers 476 and 477. Cardwell rocker side bearings and Cardwell friction draft gear are both being shown.

An interesting and valuable feature of the master mechanics' conventions of the last few years has been the attendance in large numbers as special guests of men who, while not now occupying the position of master mechanics, may in the course of time reasonably hope to succeed to that rank. The reference is to foremen of all grades, traveling engineers, boiler makers, boiler inspectors—all of whom will benefit from the consultations of their superior officers and will be all the more valuable members of the association when they become eligible.

Albert W. Jack, Vice-President of the Star Headlight Company, Rochester, N. Y., reports business so active that Albert W. Jacobs, President of the company, will not be able to get away to attend the convention.

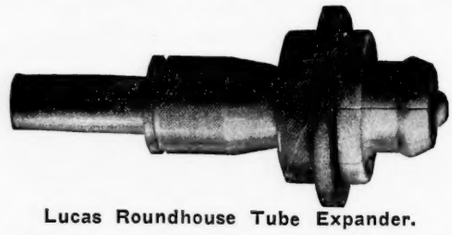
FORMER CONVENTIONS.

At the request of many of the railway and supply men at the conventions we publish the following official record of the annual meetings held by the Master Car Builders' and American Railway Master Mechanics' associations since the inception of these organizations:

	M. C. B.	M. M.
1864	July—West Albany.	
1864	Sept.—New York City.	
1865	June—West Albany.	
1865	Sept.—New York City.	
1866	June—West Albany.	
1866	Sept.—Adrian, Mich.	
1867	May—Springfield, Mass.	
1867	Sept.—Altoona, Pa.	
1868	June—Dayton, O.	Cleveland, O.
1869	June—Chicago.	Pittsburgh, Pa.
1870	June—New York.	Philadelphia, Pa.
1871	June—Richmond, Va.	Louisville, Ky.
1872	June—St. Louis.	Boston, Mass.
1873	June—Boston.	Baltimore, Md.
1874	June—Cincinnati.	Chicago.
1875	June—New York.	New York.
1876	June—New York.	Philadelphia.
1877	June—Cleveland.	St. Louis.
1878	June—Niagara Falls, N. Y.	Richmond, Va.
1879	June—Chicago.	Cincinnati.
1880	June—Detroit.	Cleveland.
1881	June—New York.	Providence, R. I.
1882	June—Philadelphia.	
1882	Oct.—Niagara Falls.	Niagara Falls.
1883	June—Chicago.	Chicago.
1884	June—Saratoga.	Long Branch.
1885	June—Old Point Comfort.	Washington.
1886	June—Niagara Falls.	Boston.
1887	June—Minneapolis.	St. Paul.
1888	June—Alexandria Bay.	Alexandria Bay.
1889	June—Saratoga.	Niagara Falls.
1890	June—Old Point Comfort.	Old Point Comfort.
1891	June—Cape May.	Cape May.
1892	June—Saratoga.	Saratoga.
1893	June—Lakewood.	Lakewood.
1894	June—Saratoga.	Saratoga.
1895	June—Alexandria Bay.	Alexandria Bay.
1896	June—Saratoga.	Saratoga.
1897	June—Old Point Comfort.	Old Point Comfort.
1898	June—Saratoga.	Saratoga.
1899	June—Old Point Comfort.	Old Point Comfort.
1900	June—Saratoga.	Saratoga.
1901	June—Saratoga.	Saratoga.
1902	June—Saratoga.	Saratoga.
1903	June—Saratoga.	Saratoga.
1904	June—Saratoga.	Saratoga.
1905	June—Manhattan Beach.	Manhattan Beach.
1906	June—Atlantic City.	Atlantic City.
1907	June—Atlantic City.	Atlantic City.
1908	June—Atlantic City.	Atlantic City.
1909	June—Atlantic City.	Atlantic City.

LUCAS ROUNDHOUSE TUBE EXPANDER

The Lucas roundhouse tube expander is for tightening locomotive flues in the roundhouse. It is claimed that 200 flues an hour can be worked with it and that they can be made tight



Lucas Roundhouse Tube Expander.

without resort to a beading tool. It is made to fit either a long-stroke or a lighter shipping hammer, the latter being recommended. The Scully Steel & Iron Co., Chicago, is the maker.

The Misses Evelyn and Marjorie Hooper, daughters of W. H. Hooper, of the Chicago Car Heating Company, are attending their first convention.

PROGRESS IN LUBRICATING MATERIAL ECONOMICS.*

One of the progressive railways of to-day compiled its first engine report in 1854, but this made no reference to expense for materials other than those included in general cost of repairs. The difficulty in obtaining authentic data prior to the early fifties can be appreciated.

The committee had hoped to present data showing weight, lubricated area and cost of lubrication per unit of service for the general type of passenger and freight locomotives in each decade from the earliest record obtainable to the present time. In this, however, it has been disappointed; as, after the most diligent search, available data is not sufficiently complete.

During the past ten years locomotives have increased in weight and lubricated area in a greater proportion than in cost of lubrication. The elements entering into operation during this period are increased weights, lubricated area, steam pressure and the unparalleled demand upon the power during the past few years, during which time the pooling system has been more or less universally adopted, at the sacrifice of some degree of personal interest on the part of enginemen. Notwithstanding adverse conditions improvements have been made, and the following statement, showing the average weights and lubricated area of engines to-day in service on eight of the representative railways of the United States and Canada, as well as the percentages of increased cost of lubrication for the five-year periods of 1898 to 1903 and from 1903 to 1908, demonstrate that economies are being made, and the committee has reason to believe that by close application on the part of those responsible for the expense of lubricants and their application further economies can be effected.

Average Weight and Lubricated Areas of Locomotives.

Road.	No. of engines.	Average weight.*	Average lubricated area.†	Per ct. inc. in cost of lubrication 1903 over 1898.	1908 over 1903.	1908 over 1898.
A.....	316	133,484 lbs.	4,092 sq. in.	.....‡	33.5	.....‡
B.¶.....	750	146,000 "	7,496 "	3.5	8.2§	5.0§
C.....	1,264	136,452 "	10,353 "	18.9	7.4	27.8
D.....	250	163,575 "	10,416 "	3.4§	3.0§	6.4§
E.....	1,067	164,521 "	8,182 "	100.8	11.5§	77.7
F.....	1,422	148,461 "	8,782 "	40.9	12.8	58.8
G.....	1,452	121,283 "	10,126 "	28.7	14.2	47.0
H.....	912	163,300 "	12,078 "	47.7	14.4	69.1
Average.....	929	147,134 "	8,941 "	48.15	7.45	38.42

*Excluding tenders.
†Includes cylinders and valves, engine and tender truck journal bearings, trailer and driving journal bearings, crank pins, guides and eccentric straps.
‡Have no cost for 1898 period.
§Percentage of decrease.
¶ The earliest period is 1900.

On several roads of which the data was incomplete one showed an increase of 32.8 per cent. in cost for 1908 over 1898, another an increase of 35.7 per cent. for the same period and one a decrease of 40 per cent. for the same period.

Back in the days of hook-valve motion, when a barrel served as a tank and a hand pump on the foot board an auxiliary, lubricating appliances were in like manner primitive.

In harmony with the general crudeness there was no communicating rod from the cab to cylinder cocks, the latter being operated from the ground. An open-top cup located on steam chest served to convey the lubricant to the valves and cylinders, and one of the duties of the fireman, in addition to kicking the cylinder cocks open or closed, was to periodically pass from the cab to steam chest and oil the valves when throttle was closed. A small cup filled with waste or wicking, and with a stopper in top to retain the oil, fed the lubricant to the pins and such other parts of the machine as could be lubricated in this manner. The driving box and engine-truck journal bearings were lubricated by means of oil conveyed through holes from top of box to the journal with waste on top of box and oftentimes wicking in oil holes to restrict the flow. Under the journals were cellars packed with sponge cut in small pieces, from which the familiar term "sponging boxes" originated. Tender-truck journal bearings were similarly equipped, and it was necessary to creep between the wheels to "oil the tank." Later, pipes leading from cups in the cab to steam chest were installed, and adjustable feed cups for machine lubrication adopted. The columns of a mechanical journal published in 1854 make mention of "a special fast passenger engine, cylinders 12½ by 20 in., one pair of 69-in. driving wheels, four-wheel truck and trailer, with total weight of 29,000 lbs., built to run 97 miles in two and one-half hours, including all stops, and to haul a train of 300 passengers. A handsome gallery extending around the engine provided a foot path to walk around, also a new feature—a handsome brass reservoir secured to the side of boiler, holding one-half gallon of oil, with pipes leading to the different journals, each supplied with a cock for letting down at pleasure of engineer while running."

In 1855 the September issue of the *American Railroad Journal* stated: "Perhaps there is no other article so liable to waste as oil; it is often the case that the method of lubrication is such that it is difficult to see when enough oil is communicated without using double the quantity needed. Should not this fact suggest some improvement in oil cups? Cannot some man of genius get up some lubricator which will feed itself automatically?" In 1869 Nicholas Siebert, an engineman in California, introduced the first lubricator operated by the hydrostatic displacement principle. This was a down-drop feed. In 1873 John Gates, of Portland, Oregon, invented the first up-drop lubricator. Improvements in that device have followed in succession.

More substantial construction, increased areas in steam pipe and condensing chamber, the change from tubular to disk type of feed glasses, have lessened breakage with consequent loss of oil, and the use of an automatic drain valve preventing the loss of oil when draining lubricators have all been factors in lubricating material economies.

The plug or screw compression cup came into use with the introduction of grease as a lubricant for crank pins. Indifferent handling of this device resulted in extravagant use of lubricating materials and loss of plugs. A compression grease cup for crank pins, automatic in action, of proper design and construction, has demonstrated economy in lubricating material, saving in labor and eliminated loss of plugs.

In the spring of 1902 a device was invented for the automatic lubrication of driving-box journal bearings with grease. Since the advent of this device, over 200,000 have been placed in service, and the delays to power, due to heating of the parts affected, have been materially reduced.

In the early experiments with grease as a lubricant for driving-box journal bearings it was thought expedient to discard the use of babbitt metal inserts in bearings. It has since been thought by some that babbitt inserts should be applied in such a manner that as expansion occurs from running temperature they will retain contact with journal and assist in overcoming the objectionable features of unsatisfactory bearing metal.

Modern practice of using grease for lubricating driving-journal bearings and crank pins has enabled a reduction to be made in the number of lubricating oil cans carried by engine crews, in some instances it having been determined that one three-pint engineman's oiler and one three-pint valve oil can, of proper design and construction, will answer the purpose of both supply cans and oilers, drawing a supply of oil for one way instead of for round trip.

Improved packing, tools, buckets, wrenches and suitable oil cans for roundhouse use have resulted in economy in lubricating materials and appliances.

The adoption of types of valve gear, other than the Stephenson link, has been a factor in economical lubrication.

More general use of the piston valve, internal admission type, has proven the necessity of locating the oil pipe in center of main steam cavity and drain valve in exhaust cavity. This arrangement of piping has been conducive to economy in lubricating materials. Valve stems and piston rods receive sufficient lubrication from the lubricated steam in steam chests and cylinders. The maintenance of a suitably enclosed swab has prolonged the life of piston rod and valve stem packing.

In the early years vegetable oils (principally olive oils) were used for machine lubrication in Europe, and, although history is vague on this subject, it is fair to assume that the first steam locomotives were lubricated with oils of this kind. Suitable materials for external and internal lubrication have progressed in the same ratio as have locomotives and lubricating appliances.

There have been times in the history of steam lubrication when anything of a greasy nature was considered a lubricant and experimented with. In the early era of steam locomotives in this country a railway publication, under the caption, "Pork for Journal Boxes," stated: "Why not use it? We have asked 50 railway men within so many days if they were aware of its success. On the H. R. R. a car was packed with slices of fresh pork, and is to-day as good as it was a year ago. The cost per box for pork packing, that will stand at least a year, will not exceed 30 cents."

A railway man who used soft soap as a lubricant seemed, to say the least, eccentric. A standard authority, "D. K. Clark's Railway Machinery," published in 1855, said: "In proportion as the bearing surfaces are fine, hard and polished, the more fluid may be the lubricating material; thus fine oil may be used instead of soap. It is probable that concussion was originally the inducement to use soap on rail-

*Abstract of a report presented at the annual convention of the American Railway Master Mechanics' Association. Committee: T. S. Lloyd (chairman), E. D. Bronner, E. F. Needham, T. Roope, G. J. De Vilbiss.

ways apart from the difficulty of preventing oil from being wasted."

Antedating the use of mineral oil, cotton-seed and sperm oil were extensively used, followed by a more general use of lard oil for machine lubrication and tallow for valves and cylinders. As early as 1854 a firm in Philadelphia introduced what they termed a "lubricating grease adapted to use on all classes of running stock of railways." They recommended it on account of its "freedom from gum or glutinous substances and adaptability to all kinds of weather." The *Railway Press*, which apparently was an alert and quick to grasp any ideas in lines of improvement in those days as it is to-day, commented on the new lubricant as follows: "Oils are very high, and notwithstanding numerous inventions which have been made to relieve them from a portion of the demand, they continue to advance. A cheap material for efficient lubrication is very desirable. All things nowadays require more light and lubrication."

The mineral oils or petroleums were placed upon the market in the years soon following and on account of their cheapness and superiority as a lubricant their use became general. The natural West Virginia oil, with its notable characteristics of a low cold and high fire test, immediately found favor and was considered superior to sperm. The production of the West Virginia oil was limited, and as the demands rapidly increased the supply was soon exhausted. A manufacturing concern in 1869 introduced for railway service an oil for external lubrication, combining the excellent qualities of nature's best lubricating product with other ingredients, producing an article which met all of the requirements of the day; an oil of low cold and high fire test, a gravity permitting of ready flow, and the sustaining power for support of the ever increasing loads upon the bearing surfaces. This lubricant has stood the test of service from the date of its introduction and is now used on the majority of the railways of this country, as well as on many of the English and European lines.

Prior to the introduction of mineral cylinder oil, tallow was the almost universal lubricant for valves and cylinders. In some few instances lard oil mixed with plumbago was used, and grease introduced through cups with double stop cocks was tried, but melting tallow in the old familiar tallow pot was practically the universal practice for many years. Tallow carrying a high percentage of acid was found objectionable, the acid attacking the metal, pitting and rendering it porous and weakening its structure. Designing skill was devoted to the avoidance of pockets where this material might find lodgment, thereby permitting partial disintegration of the metal.

The superiority of an oil free from acids with greater viscosity, less liable to gum, and with a higher fire test to meet the increases in temperature was fast relegating tallow to other uses. With cylinder oils it was the same as with machine oils; qualities ranging from excellent to unfit being used. In 1870 there was placed upon the market a cylinder oil meeting all of the desired requirements and furnished from a source of supply that insured uniformity in quality and quantity to meet all demands. This cylinder oil has stood the test through all the gradations of temperature as steam pressures have increased from 120 to 230 lbs., and the higher temperatures incident to the use of superheated steam.

Although the decade just closed has been an era of wonderful development, the lubrication of valves and cylinders on locomotives with high steam pressure or equipped with superheaters has not required any change, so far as cylinder oil is concerned.

The limited experience in the use of superheated steam locomotives in the United States has not definitely established the amount of oils necessary for supplying internal lubrication. From the records of the railway now using the greatest number of superheated locomotives, it is shown that miles run per pint compare favorably with other roads not having superheaters in their locomotive equipment. A less extended experience on other lines has not proven the necessity of materially increasing the valve oil allowance above that furnished locomotives using saturated steam.

The rapid introduction of heavy power and the demand for the service of all power with but brief periods at terminals necessitates the use of grease on crank pins and driving-box journal bearings. The extended use of this material has proven economical, and also satisfactory from a service standpoint, for use on such bearings where the thrust due to reciprocated parts will permit of its use.

The use of a superior quality of waste for box packing purposes has been beneficial from a service standpoint and has proven an economy.

Since the time when any space that could not be utilized for other purposes was designated the oil room, wherein stock was carried in open barrels, with a convenient ladle or measure permitting the drawing of an unlimited supply; when the packing for boxes was mixed on the "spot" in a bucket or possibly on a shovel; when tenders were oiled from the coal hod, we have progressed to the present-day methods.

In recent years most decided improvements have been made in the construction and arrangement of oil houses, sufficient capacity being provided to permit of oils being secured in tank-load lots, at reduced cost, for system, division or local distribution as requirements of the companies demand.

The adoption of a system for the handling and distribution of oils by actual measurements has economized in lubricating materials, oil cans and measures and resulted in a reduction in labor expense.

Economy has resulted by the quite general adoption of methods whereby packing is prepared in a room of moderate temperature, a good quality of waste being thoroughly saturated by completely submerging it in oil for not less than 48 hours, then draining off surplus oil, using approximately four pints of oil to each pound of waste. This progress has been improved by mechanical means, increasing the capacity of saturating tanks, and obtaining a product with the proportions of oil and waste exactly as desired by the company preparing it.

Greater attention is daily being given to the application of prepared packing to engine, trailer, tender truck and oil-lubricated driving boxes. The packing worked in cylindrical form and applied to cellars in sections, care being exercised to keep edges of the packing tucked in around the edges of cellars, thereby preventing siphoning of oil, has proven most satisfactory, and with the well-known present-day methods of packing journal boxes, economy has been effected and service conditions bettered.

Journal-box packing that in former years would have been used for lighting fires or thrown away now goes through a process of reclamation, and a large percentage of it is returned to use. The process of passing old packing through a picker, by which dirt and short strands of waste are separated from the good and usable material, has been used to advantage. An inexpensive and very satisfactory method of reclaiming oil packing is by placing it in a properly constructed tank with heat attachments to heat the oil. The expansion of the oil separates the strands of the waste, thus permitting the foreign deposits to be readily shaken out. The reclaimed packing after surplus oil has been drained off can be placed in the same service as new materials; the refuse drained through a combined strainer and filter puts the oil in condition for further service. The economy resulting from the reclamation of lubricating materials is supplemented by a saving in waste and babbitt metal.

The preparation of grease cakes by power press and molds of proper form and size in rod cup and driving-box journal lubricators, etc., protected from impurities until applied, in addition to careful attention to the cleaning (which can best be done by removing dust and dirt with a putty knife or tool of that character), and the re-use of grease removed from cellars undergoing repairs has resulted in pronounced lubricating material economies. Service has improved and economies have been effected by discontinuing the use of free oil in engine houses, treating all boxes with prepared packing.

Much of the credit for economies that have been effected in lubricating expense is, and justly should be, credited to accounting, the progress along which line has been in keeping with that shown in the other features mentioned in this report.

From the time when company material was comparatively free to all without restriction, as to the quantity supplied, or disposition, to the minuteness and accuracy of the present; from the capacious pockets of the foremen, who carried an assortment of small bolts, nuts, washers, etc., for immediate delivery, to the systematic stores department of to-day, are advancements that can only be appreciated by mechanical department employees who have been in the service for a number of years.

It has been mentioned that the first compilation of engine reports is well within the memory of some now actively engaged in railway work. Calling attention to the benefits to be derived from working under a contract system, and urgently recommending an itemized accounting for fuel, oil and miscellaneous supplies the article referred to concludes as follows:

"I would urge on every company the propriety of keeping a separate account against every engine; that every stick of wood, every gallon of oil be accounted for by someone. It gives a little more trouble in the office, but it saves immensely out of doors. It introduces a spirit of emulation and rivalry among the men, highly beneficial to the company, and if, in addition to this, premiums were given for economies in wood, oil, tallow and other materials, it would be a great encouragement for good work and the expense would be ut-

terly disproportionate to the saving effected. A man will soon tire of making exertions to economize if he gets no advantage over his neighbor who refuses to put himself out of the way, and any system that pays a man in the proportion to the work he does and the skill manifested, must, in the long run, have the effect of bringing the best and steadiest men to the place that their qualifications are the best measured."

Accurate data of the accounting feature of lubrication in the earlier days is unobtainable, but from living participants in the events of that time it is learned that, prior to any systematic method of accounting, a gallon of lubricating oil was considered sufficient for 100 miles, a performance of 12.5 miles to a pint of oil; more than this could be had if called for. The allowance of tallow was unrestricted and an engineman was giving excellent service when 80 lbs. were used for 2,600 miles, a mileage of 32.5 to one pound. The average consumption was 150 lbs. for 2,600 miles, and it is said that sometimes as much as 230 lbs. were used.

The railway from whose records the above was secured introduced the premium system on coal and oil in 1855, and opened a record showing the individual performance of engines and men. Other roads operating in the same territory adopted this system at the same or a somewhat later time. The figures which follow are not a sequence to those already mentioned, but apply to two roads—now important systems in the eastern section of the country.

Road A.—In May, 1855, the average miles run per pint of lubricating oil was 10.4; to pound of tallow, 18.89.

Road B.—Same month, average miles per pint of lubricating oil, 14.62; to pound of tallow, 41.1.

The advantages gained in the adoption of performance reports were obvious, and one of the railway journals, in its September issue of 1855, editorially advocated the keeping of records and the benefit of giving publicity to them.

Reducing the consumption of lubricating materials did not benefit the manufacturers, except as each improved performance gave publicity to the merit of their production.

One of the lubricating supply companies, in 1876, submitted to the various railways of the country a proposition to furnish lubrication on a guaranteed cost per unit of service, with the additional provision that it would co-operate with the railways in meeting the contract obligation and securing the best possible service. In order to live up to the contract requirements, it employed a force of lubricating experts, assigning them to different sections of the country, with instructions that they work in connection with the mechanical department officials of the various roads with whom they had made contracts, watching the practices of the railway employees whose duty it was to care for and apply lubricants and lubricating devices, giving instructions as to modern methods when necessity or good service demanded, and being fully familiar with all details. Their services, added to the close attention that is paid by the general and divisional offices of the mechanical departments to lubricating accounting, has resulted in economies and betterment of service.

The accounting features pertaining to lubrication, while differing in minor details, are, in a general way, uniform on the various railways in this country. The managements have ascertained that the practice of charging oils to enginemen as well as to engines, and submitting monthly statements showing the amount of oils drawn by each engineman, in excess of allowance, has resulted in reduction of lubricating expense.

The preparation of divisional and system statements compiled in comparative form, showing the amounts of oils used per thousand miles and cost of same, said statements carefully watched by system and divisional department heads, and corrective remedies applied when the lubrication expense exceeds in amount that deemed necessary, have proven efficacious and resulted in a decided economy.

In summarizing the factors in lubricating economies the following are most prominent:

Designs of locomotives with features whereby lubricated parts have been made readily accessible.

More general use of types of valve gear with lubricated parts accessible, and further permitting easier access to other lubricated parts.

Improved construction and location of lubricators and piping, namely, locating all lubricators where feed can be readily observed, both day and night by enginemen, high enough that all oil delivery pipes have gradual fall from lubricator to steam chest or point of delivery.

Close attention to choke plugs.

Careful attention to material entering into the construction of journals and bearings and condition thereof.

The use of grease for lubrication of crank pins and driving-box journal bearings.

The adoption of proper devices and methods for the use of greases.

Improved method of packing engine trucks, trailers, oil-lubricated driving journal cellars and tank-journal boxes with properly saturated waste.

Improved storage and measuring facilities for oil.

Careful attention to renovating and reusing prepared packing and greases.

Uniformity in accounting, etc.

TENDER TRUCKS.*

After making investigation and getting replies to certain questions asked, and also from personal observation and experience, the committee believes that the arch bar, cast-steel side frames, and pedestal trucks, which are now in very general use in all kinds of service, will, if correctly designed, be thoroughly reliable for high and low speeds.

The pedestal type of truck, whether having side equalizers and half-elliptic springs, or with the double-elliptic springs, or with coil springs over the boxes, is a more expensive truck to maintain than either the arch bar or cast-steel side frame type, with the journal boxes rigidly attached.

Under general conditions it does not advise or recommend the use of coil springs over journal boxes, as they increase the wear on box and pedestal without giving correspondingly better results in other directions.

The use of elliptic springs is strongly recommended. For slow service, such as switch and transfer work, coil springs can be used, but would not recommend them for any other kind of service, because of their excessive movement and number of vibrations before coming to a state of rest.

Side bearings should be used on each truck and in all cases it recommends that their location be less than width of track, or, in other words, should be inside of wheel flanges; if any difference of spread of side bearings is made in the two trucks, it should be greater at rear truck than front one with above limitations, and would suggest 36-in. centers for front truck and 50-in. maximum for rear truck.

From replies received and from personal experience, it finds roller or other kinds of so-called frictionless side bearings are not in general use, and although it has reports of flange wear being reduced where they are used, it is not satisfied that they are necessary, as with proper clearance between solid side bearings practically the same results can be obtained.

The use of roller center bearings does not seem to be very general, and the committee does not believe they are necessary for tenders.

While twenty-three replies to letter of inquiry object to the arch-bar truck, and have various reasons—among others, rigidity, breakage of arch bars, number of parts, load not properly equalized, not as smooth riding as pedestal type, difficulty to keep in alinement, etc.—yet the committee believes that when properly designed and good material used in its construction, it is entirely satisfactory, and is less expensive to build and maintain than the pedestal truck.

It recommends that side-bearing clearance should be from ⅛-in. to ⅜-in., and when the side-bearing spread is the same on both trucks, the greater clearance should be on the front bearings, but where the spacing is less on front truck than on rear one, the clearance should be arranged so that both bearing on same side touch together, or at same time.

In regard to tender-truck derailments, the committee finds that some tender trucks are more liable to derailment than the trucks under other railway vehicles. In answer to the circular of inquiry, the following were reported as some of the causes of tender derailments:

Bad track conditions, high center of gravity of tank, rolling action of water on account of splash plates being out of place, coil springs, short wheel base, shallow center plates, center plates not fitting, too much rigidity, improper location and clearance of side bearings, lack of clearance between drawbar and end sill; on prairie type engines by excessive lateral swing of engine, depression of track by rear engine driver ahead of front tender truck, causing more front trucks to be derailed than rear ones, the steadying effect of cars helping to keep rear trucks on track.

In two cases it was found that derailments of tenders on lines where they were frequently occurring ceased when the changes were made as shown below:

Ry. No. 1: Arch-bar trucks having swing motion bolster with side bearings spaced 50-in. centers on both trucks, and with about ¼-in. vertical clearance on all side bearings, substituted for arch bar and pedestal truck without swing motion bolster.

*Report presented at the annual convention of the American Railway Master Mechanics' Association. Committee: H. T. Bentley (chairman), John Hair, Q. E. Manchester, J. F. Walsh, T. H. Curtis.

Ry. No. 2: The trucks in use were arch bar, with rigid bolster and cast-steel side-frame types; one tender was equipped with pedestal truck having side equalizers. With each of above type, derailments were of frequent occurrence. The side bearings on above trucks were spaced in some instances 56-in. centers, and others 48-in. centers. The derailments of those tenders was stopped by spacing side bearings 36-in. centers on front trucks, with ⅛-in. clearance, and 48-in. centers on rear truck with ¼-in. clearance, each side.

The committee believes that tender derailments can be practically overcome by the use of properly-designed trucks having rigid or swing motion bolsters supported by suitable bolster springs, either elliptical or half-elliptical, double or triple, and when side bearings are properly located, having a spacing of 36 in. front where possible, and 48 to 50 in. at rear end. The types of truck may be of the arch-bar or steel side-frame pattern, with journal boxes rigid with the arch bars or side frames; or of the pedestal type having arch bars or solid frames with springs over the journal boxes; or of the pedestal type having side equalizers with half-elliptical springs between the equalizers.

The tender should be as long and low as possible. Spring buffers between engine and tender give flexibility and reduce liability of derailment due to solid chafe irons binding or sticking, on account of wear. The buffer face and bearing on engine should be amply large and well rounded to prevent locking. It does not believe that splash plates in tank help to overcome derailments.

Where proper clearance is not allowed between center pin and truck-center casting there is a possibility of truck not curving, and derailments under such a condition are possible; ¼-in. clearance is recommended. Center plate should be flat, and not less than 11-in. diameter set down at least ¾-in. in center plate.

Tender trucks should be built low as possible, consistent with proper clearance. It is absolutely necessary that ample clearance be allowed for free movement of drawbars at both ends of tenders. The front drawbar should be straight, with its center the same height above the track as that of rear coupler, if possible.

The responsibility for either method of hanging brakes (inside or outside) actually causing derailments could not be verified, as both methods are being used successfully, with perfect freedom from derailments when applied to properly-designed trucks.

Wheel base of truck should not be less than 5 ft. 6 in., although shorter ones are in service.

Where safety chains are used, they should be of sufficient length to enable truck to go around the shortest curve, and when tender is rocking.

FUEL ECONOMIES.*

Your Committee, appointed to consider what progress has been made in fuel economy, herewith submits the following report:

We have considered this subject in most of its different phases and bearings, from a practical standpoint only; since when one undertakes to make any further classification of it, he is led into the realm of many technical connections which already form subjects being investigated by other committees of this association. We have no disposition whatever to minimize the importance of their influence upon the very large question of fuel economy, but if we undertook to institute an investigation covering the value to this question of the subjects mentioned below, it would require several years' time to complete the report, and that would call for a corps of stenographers and clerks, and other necessary accessories to make an intelligent showing on such a gigantic subject; and the committee would need an appropriation of several thousand dollars to carry on the work, so that it would probably be quite sufficient to confine the work of this committee entirely to the practical side of the question, giving particular attention to the efforts and instructions of engineers and firemen in connection with the subject.

1. Compounding.
2. Steam distribution.
3. Superheat.
4. Relative diameter of wheels to diameter of cylinders.
5. Loss of pressure between boiler and cylinder.
6. Loss by radiation.
7. Economic boiler design, in relation to horse-power.
8. Feed-water heating.
9. Loss by air pump and waste.
10. Quality of feed water.
11. Exhaust stand, nozzle, stack and front end arrangement.
12. Brick arches and water tubes.
13. Grate design and relative area of bar and air space for different kinds of coal.
14. Air inlet to ash pans—a subject much neglected.
15. Fire-door design.
16. Auxiliary air inlets and smoke consumers.
17. Preparation of coal for use.
18. Storage of coal to avoid loss in heat value per pound.
19. Purchase of coal on the basis of heat value.
20. Automatic stoker.
21. Hot-water service in engine house.
22. Banking or dumping fires.
23. Methods and time for firing up engines.
24. Time lost on road at meeting points.
25. Instructions and control of engineers and firemen.
26. The influence upon fuel economy of progressive examinations of engineers and firemen.

Your committee, at a meeting held in Chicago, February 4, 1909, prepared and had sent out to all members of the association a list of questions bearing on the subjects of the progress made in fuel economy, and to those questions many replies have been received, the tenor of which is that the question of fuel economy is receiving considerable attention from the officers of the many railways in this country. From a few of them it is getting specific and close study, with a fuel department detailed to work out the problem, commencing at the mines to inspect and select the coal and have it prepared for use as well as it can be before shipment is made to the different points on the various systems. The idea is to make an effort to have the coal thoroughly cleaned and as free from slate and all other noncombustible matter as is possible, so that when it is distributed to the several coaling stations the best results can be secured from it. If this is done as fully as possible there will be an inspiration for the engine crew using it, and for all those whose duty it is to supervise its use from the mines to the firebox, so that much greater fuel economy must result from following the latter plan.

At St. Louis, Altoona, and on one railway that replied experiments have been made with briquetted coal. On the latter road, briquettes were made up of fine anthracite obtained from the washeries in the anthracite region, this being dried and mixed with a binder, which is some form of pitch, the resulting mixture being compressed, when it is ready for use.

Comparative tests were made of bituminous and briquetted fuel. While the data obtained were quite interesting, it was quite clearly demonstrated that the value of briquettes as a fuel in comparison with coal is far from favorable, as shown from the fact that only 6.30 lbs. of water were evaporated per lb. of briquetted fuel from and at 212 deg. F. as compared with 8.83 lbs. of water evaporated per lb. of bituminous coal.

In connection with this test it was observed that the flame was very much shorter with briquettes than with bituminous coal, while it is quite essential that the long flame should be maintained at all times in the deep fireboxes. On account of the briquettes not producing a long flame those making the test were under the impression that fuel of this kind would be more satisfactory in shallow fireboxes instead of deep ones, although the engine in which the test was conducted was not what might be considered a deep firebox.

It was also found that the action of gases upon the eyes of the firemen was unfavorable, as complaint was made in regard to it, due, it was assumed, to the binder employed in making briquetted fuel.

In some instances, particularly on one of the larger systems, it is intended to purchase coal from specifications made up by the mechanical department, but as yet this practice has not been developed far enough to give an elaborate explanation of it to this convention. It is sufficient to say that there is at present a thorough coal inspection system installed with competent coal inspectors located at the mines to continually inspect and mark all cars set aside for company use. The inspector has authority to reject any and all coal that does not meet the specifications of the company. He also makes it his business to frequently send samples of coal from any and all cars loaded for company use for test and analysis to the chemist, to whom the coal inspectore report. It is also within the province of the mechanical department to see that the coal is distributed to the different points on the system at the least possible cost; price and hauling, as well as handling and quality best suited to use in certain territories, are considered.

The mixture of the poorer with the better grades of bituminous coal, and of anthracite and bituminous coals in specified percentages, have been established by the proper officials of the mechanical department.

The placing of coal on engines in large-size cubes is not conducive to fuel economy, as, by doing so, too much of the fireman's time is taken from watching the fire in order to properly prepare the coal for use, or it is introduced into the

*Abstract of a report presented at the annual convention of the American Railway Master Mechanics' Association. Committee: W. C. Hayes (chairman), R. P. C. Sanderson, D. R. Mac Bain, T. B. Purves, Jr., W. H. Wilson.

fire box just as it comes from the mines, altogether too large for economic results. It is very evident that it will pay to see that coal is placed upon the engines in suitable sizes for firing, so that the fireman may be able to devote his entire time to watching, controlling and feeding his fire.

In the opinion of the committee the base of the whole question of fuel economy is contained in beginning at the mines, so as to be absolutely sure that no imposition is practiced by having noncombustible material palmed off for coal, and to see that the coal is properly cleaned. To do this it will be found necessary to keep competent inspectors at the mines with authority to reject all coal before shipment that does not come up to certain standard specifications upon which all coal should be purchased.

Under the old plan of purchasing coal when the consumer (in this case a railway company) had cause or thought they had cause to find fault with the quality of coal received, everyone whose duty it was to supervise and look after its use was at once assured that the coal must be good, because, like all the coal sent forward, it came from a mine with an established reputation, and the mine owners and their representatives frowned down any attempt on the part of the company to condemn any of their product. It is obvious that such a state of affairs would make it very difficult to take advantage of the competition which usually results when a considerable number of bidders are asked to submit prices. The purchaser was [illegible]d to buy from any but such dealers as he knew and [illegible]ed, for the reason that although each dealer claimed his coal was of as good quality as any other, yet when it proved to be unsatisfactory there was no standard for settlement or for abrogation of contract. Many thousand dollars' worth of fuels are bought each year in this manner, but the purchaser would think it unwise, or even ridiculous, if he was asked to let a contract for the building of a house, or in fact, any building with no specifications, but simply on an agreement that it should be of a certain size and dimensions and be well built. Neither would they purchase gold, silver, or even copper and iron ores simply on the knowledge that they were mined in a certain locality. It is believed that the time is rapidly approaching when the production of all mines will be purchased upon their value as shown by a complete chemical analysis. This is true of coal at the present time only to a small extent, but the number of contracts made based upon the number of B.t.us. can be furnished for one dollar is bound to increase every year. The road above referred to furnishes data sheets showing just what B.t.us. are furnished in each kind of coal used for one dollar to officials engaged in the extension of fuel economy. The purchase of coal on specification is as much of an advantage to a railway company, or to any buyer, as a definite understanding of a building operation or engineering project is to the engineer, because when coal is bought to a specification you get what you pay for, and pay for what you get.

When the bidder is allowed to specify the quality of coal he proposes to furnish as determined from a chemical analysis, he is placed on a strictly competitive basis with other bidders. This broadens the field for both the bidder and the purchaser. It makes the bidder's proposal, when accepted, a contract which specifies an established standard of quality. This furnishes a basis for settling disputes regarding the coal delivered and the price to be paid if the fuel is either better or poorer than has been guaranteed. If other coal must be substituted, as often happens, there is a basis of settlement. If the coal is uniformly poorer than the standard as specified, there is a basis for cancellation of the contract. The cities of Chicago, Indianapolis, Minneapolis, St. Paul, St. Louis and Cleveland purchase coal on this basis, as do some of the other large cities. There is, however, some variation in the B.t.us. allowed by the different cities which purchase coal on this plan, but in general a standard is fixed at nearly 14,000 B.t.us. Coal falling below that standard may be used or not by the purchaser. If, when an inferior grade is used, an average is struck when the monthly settlements are made, it can be plainly seen that the material reduction in the prices of the coal will soon cause the mine owners to sit up and take notice. The result will be that the standard fixed in the bid will be maintained.

One of the essential things which many of the railways are now trying to establish is to figure on the grade of coal best suited to a certain territory, to then assign this coal to that territory and have it definitely understood that no change will be made except in case of a grave emergency, such as a miners' strike, floods, storms, washouts, etc. This will enable engine crews to become acquainted with the quality of fuel furnished. Engines can then be drafted to suit, and thus insure greater improvement in fuel economy than if the old plan were continued.

The proper essentials of fuel economy and the conditions obtaining in a locomotive boiler on which that depends, should be as folows:

1. A clean boiler whose shell tubes, sheets and stays (and in addition "the crown bars," in the crown bar type of boiler), are kept free from mud and scale.
2. Properly drafted and good steaming engines.
3. A good quality of fuel properly prepared for use.
4. Efficient operation of the locomotive.
5. Individual fuel records.
6. A full and fair accounting.

Economy in the use of fuel on a railway is at all times a very interesting, though perhaps a perplexing, problem. There are so many items which enter into its makeup, both from a mechanical and an operating standpoint, that the fuel question is always bobbing up serenely and presenting itself for solution. The fuel account being one of the chief items of expense on every railway, all officials having charge of train and engine men should work together in order to secure best results. To do this, we are very much inclined to think there should be a mutual understanding concerning the leaks, and a combined effort should be made to stop every one of them.

The design of a locomotive boiler should be such as to give as large a heating surface, both box and tubes, as possible with large grate area, in order to provide for a slow rate of combustion. Provision should also be made for a good free circulation of the water and also to see that flanges are properly turned, so that no traps are formed to accumulate dirt and scale. The care of the boiler should be closely looked after, both as to proper blowing out at terminals and on line during every trip. This, together with good washing at terminals and proper care in handling, will extend its life and usefulness and materially aid fuel economy. The study and attention now given to locomotive boiler design as compared with some years ago is marvelous. This is a good thing. The care now given to locomotive boilers in service by all railroad companies will undoubtedly materially assist in the promotion of fuel economy.

The second proposition—*properly drafted engines.*

Improperly drafted engines are, perhaps, one of the greatest sources of trouble on many of our railroads to-day. It therefore goes without saying, that it is entitled to and requires constant and close supervision and attention, because on account of some defect in the draft apparatus that has escaped notice, much waste of fuel occurs.

It is not considered necessary in view of the knowledge of the members of this Association concerning draft appliances, to mention the value of the different devices other than to say that what is known as the Master Mechanics' standard, strictly adhered to, gives most satisfactory results.

The third essential is *a good quality of fuel properly prepared for use.* In order to get the best results, the coal should be placed on the tenders of the engines in such a size that the fireman can devote his entire time and attention to watching and feeding the coal to the fire. Anything which interferes with his doing so is at the expense of a certain amount of coal wasted. We do not undertake to say how the above can be accomplished on any railroad, on account of the different methods of handling fuel, employed on docks or coal tipples, and thence to the tenders of engines, but we contend that the better the coal is prepared before being placed on engines the more economical its use will be. The first section of the proposition hardly needs restating, that is, furnishing a good grade of fuel tends to its economical use; it is our firm belief that all classes of enginemen will do better work, and will use greater effort to save the good coal in all ways than will be the case when a poor grade of fuel is furnished. We are fully aware, however, that in some instances this has not proved to be the case, but the causes which led up to that belief are so indefinite as to be of no value in determining the above question. If this is true, it follows, then, that the proper preparation of coal for firing has considerable influence on the completeness and rapidity of combustion, and consequently on the temperature obtained in the fire box and on the prevention of black smoke.

The rapidity with which a lump of coal will burn depends, among other things, on the amount of its surface presented to the fire, so that if the lump is broken into a number of small pieces it follows that it will present a much greater surface, will burn faster, and will create a much higher temperature with the same quantity of coal on the grates. Other advantages are that the small coal can be spread more evenly over the fire, a thinner fire can be maintained and the thickness of the fire can be regulated more readily for the proper admission of air through the grates, thereby securing a higher and more even temperature in all parts of the fire box, and, as naturally follows, also a better combustion of the fuel.

The fourth proposition—*efficient handling*—involves the work of both the engineer and fireman, and to our minds,

constitutes one of the most, if not the most important element in fuel economy.

The question of running an engine in order to get most economical results involves the work of both the engineer and fireman, and is so important from that point of view that we shall introduce this portion of the subject by making the following statement:

An engine may be built of the very best material, and of the most approved design, i. e., mechanically perfect, with all the modern conveniences to assist in its perfect manipulation, and you place that machine in the hands of an incompetent engineman and you have almost nullified the combined expert skill necessary to turn out the finished product. We think you will all agree it is most important that the finished machine should have skilful operation.

Naturally the question will be asked, how can this be accomplished? To our minds, the answer is plain enough. It is largely a question of education by beginning with the future engineer and training him from the time he enters the service in the way you would have him go in regard to the duties of a fireman, and subsequently with regard to the duties of an engineer, establishing an educational qualification as a condition of employment, and later requiring such examinations from time to time as will tend to bring his fitness for the duties of a fireman, and his application of the same, into definite shape.

Our reason for stating when we opened the question of the operation of locomotives, that it involves the work of both the engineer and fireman, is as follows: The manner of firing and feeding water to a boiler has much to do with its steaming qualities. To get best results, these two operations must be performed in harmony with each other.

Then follows instructions for explaining by chart as a basis for instructing engineers and firemen in order to assist them in securing results in fuel economy:

One figure shows the system of heavy firing at the furnace door, resulting in a bright fire over a portion of the fire box, with a consequent reduction in fire-box temperature. This view represents a system of banking the fire on the back portion of the grate surface, say, from about the middle of the fire box back to the door, which would result in forcing one-half of the grate surface to perform the work that was really intended to be covered by using the entire grate surface. This method of firing shuts off the supply of air from the back portion of the grate surface, and, as before stated, forces the forward portion of the grate surface to perform all of the work that was intended to be done by the entire fire box, showing plainly by the path of the flame a very heavy fire in the back portion of the fire box.

Another figure shows a system of shallow and level cross-firing with slight building up around the edges or walls of the fire box, producing a bright fire throughout, with high temperature within the whole fire box.

These two views, in our opinion, are the most instructive that could be well imagined; the former showing a perfect condition; the latter showing an imperfect condition of fire.

We are quite sure that you will find these charts of great value to you in instructing firemen in their respective duties with reference to handling coal, and it furnishes something which, in our opinion, is very valuable to talk to the engineers about, as well as furnishing you with an object lesson to very clearly illustrate your work.

In introducing this system it is of the utmost importance that the engineer and fireman work very closely together in the operation of the machine. The engineer, in our opinion, should be the leader, and should be most careful in starting from a state of rest and in forcing his train into speed, to treat the fire as lightly as possible, at the same time keeping in mind that a good engineer always figures on allowing his fireman to build up his fire before putting his injector to work when starting from the stations and other points where the train is brought to a stop, thus giving the fireman every advantage that can be given to enable him to build up his fire to a point where the maximum steam pressure can be maintained with water being supplied to the boiler almost as fast as the engine is using it (in no case where an engine is working should water be supplied any faster than it is being used).

With these observations, we leave this matter entirely in your hands, so that you may get the best results possible out of the plan suggested.

The engineer should so regulate the water in his boiler as to have a sufficient quantity to enable him, when starting from a station, to shut off the injector while his train is being brought to speed, in order that the fire may be given every advantage and the steam pressure maintained at the maximum. The fireman may be ever so capable and may do his best to make a good coal record, but if the engineer does not perform his work with a view to economy, the fireman's efforts will prove futile. The fireman may save by the ounce while the engineer wastes by the pound, if they work independently of each other. This would certainly be considered very poor management, as both must work together in order to get best results. The engineer should be taught never to work his engine harder than is necessary, consistent with the train to be hauled and the time to be made, and that it is not always the man who makes the most noise pulling out of a station who makes the best time on the trip, because by that very act the draft on the fire may be of such a character as to cause his engine to fail before she gets to the next station, and the engineer in charge may be unable to assign it a cause. The fireman should be taught that heavy firing is wasteful, and should always be avoided; that the introduction of large quantities of coal at one firing absorbs very large quantities of heat, and reduces the temperature of the fire box below the igniting point of the volatile gases, allowing them to pass out of stack unconsumed in the form of black smoke. Then, again, the greater the volume of gases the more difficult it is to mix them with air, which is absolutely necessary in order to effect complete combustion.

Variation in the temperature of the fire box has also other bad effects. It causes alternate contraction and expansion of the sheets, which in due time result in leaky flues, cracked sheets and broken stay bolts.

The above effects will be present in a much less degree when the coal is fired in smaller quantities, and for this reason it is desirable to use only a small amount at a time and fire more frequently. The quantity to be fired at a time depends largely on the work to be done, the quality of the coal used, and the size of the engine. No hard-and-fast rule can be made, but it is safe to say that the best results can be obtained by using small quantities and firing often. The firing should be done at regular intervals, and the fire door closed after the introduction of each shovelful, and it will be found to be a good practice to keep the door closed a few moments after each shovelful, so that the temperature of the fire box will have time to recover from the effects of the last opening.

Every shovelful should be spread over the surface of the fire as evenly as possible, and the sides and the corners should be kept well built up and covered. If the coal is piled into the fire box in heaps it will burn slowly like so many individual chunks of coal, besides acting as a blanket at that spot, the result being that clinkers are formed and the engine steams poorly.

It is conceded by all conversant with the facts that nearly 15 pounds of coal are wasted through a 3-inch pop valve every minute during which it remains open, and a pop rarely opens and closes in less than a minute. Our observation, as far as the control of pop valves is concerned, unless exceptional care be practiced, is that 3 per cent. of the boilers upon any railroad are blowing off continually during the twenty-four hours. If this be true, a few figures will demonstrate just what the waste is: 2 per cent of 1,000 engines is about the number that will be found to be blowing off day and night. This we consider a conservative estimate. This would waste in the vicinity of 78,840 tons of fuel per year; computed on the present average price per ton would amount to the snug sum of $111,164.40. Just think of paying that amount for a leak which ought to be stopped, and can be if all railroad officials will unite to stop it. Is it worth the effort? We are inclined to think you will decide in the affirmative.

The fifth proposition—*individual fuel records.*

The subject has a far greater influence on the coal pile than one would think possible at first blush. Our plan would be to have a performance sheet showing the individual fuel record of every engineer and fireman on each district, the coal to be charged to the engineer instead of the engine as at present, establishing an average—a maximum and a minimum cost per ton-mile on each district.

We are fully satisfied that, after this sheet has been issued a few times so as to give enginemen an idea of its working, it will stimulate a great interest in the direction of fuel saving. Once let it be understood that such a scheme is on foot, and it will establish a spirit of competition among the men that will mean dollars to the company.

The sixth proposition—*full and fair accounting.*

This is an item having considerable influence on the fuel. Let the idea become circulated among the enginemen that they are getting the worst of it, in having more or less coal charged to them than should be the case, and you will find that it has a disheartening and demoralizing tendency, which will militate against the coal pile by creating a "don't care" spirit indicated by the idea that they do not get credit for what they do. The feeling should be carefully guarded against, as it creates an outgo instead of an income.

In conclusion, let it be emphasized that, after going thor-

oughly into the subject of fuel economy as far as the practical side of it is concerned, we will say that we are of the opinion that best results can be obtained by having the engineers and firemen subject to instruction from the mechanical department only; and for this purpose the road foreman of engines should be on the mechanical staff and report to and receive his instructions from the chief mechanical officer, or his representative. When this is the case the field work is not divided, and much more can be accomplished than when the subject is worked out between two departments.

M. M. CONSTITUTION AND BY-LAWS.*

The following amendments to the constitution and by-laws are presented for adoption:

ARTICLE II—Objects of Association; add the following paragraph:

"Subjects involving legal, transportation, permanent way or traffic questions, or for any other reason requiring such action, may be submitted as recommendations to the "American Railway Association."

CONSTITUTION.

ARTICLE VI, SECTION 2—Executive Committee; add the following:

"It shall also determine which, if any, of the subjects presented at the convention, or by the members, shall be referred to the American Railway Association."

BY-LAWS.

Additions:

X. The reports of all standing and special committees must be in the office of the secretary not later than April 1, in order that the same can be printed and advanced copies issued by May 1.

XI. Committee reports which do not reach the secretary in time for printing and issuing by May 1 will be referred to the Executive Committee to decide whether the report shall be submitted to the convention.

XII. The chairman of standing and special committees will read an abstract of the report of the committee before the convention, together with whatever additional data may have been accumulated after April 1, to the date of the convention.

XIII. The members of standing or special committees who may individually or collectively submit a minority report must prepare the same, so that it can be issued with the report of the majority of the committee, to substitute for the majority report in the event the convention should so decide.

XIV. Each member of a standing or special committee sign either the majority or a minority report.

SUGGESTIONS CONTAINED IN THE PRESIDENT'S ADDRESS.†

The following words in the address of the President are significant: "We are face to face with several changes in the development of our motive power and the department having charge of it."

Your committee feels that it must consider the spirit of this able review of the situation as well as the specific suggestions offered.

Your committee would respectfully recommend the adoption of the following resolution:

Resolved, That the Executive Committee appoint the following:

A committee to report at the next convention upon the heavy articulated locomotive, considering its advantages, disadvantages, possibilities and limitations, from the operating standpoint.

A committee to report at the next convention upon the electric locomotive, considering its advantages, disadvantages, possibilities and limitations, from the operating standpoint.

A committee to report next year a plan whereby the work of the railway clubs and that of the association may be coordinated for the assistance of our committees, for the discussion of subjects in detail in their relations to local conditions, for the educational advantage of minor officials, and for the conservation of time in the conventions of our association; the purpose being to gain for the Master Mechanics' Association the assistance of the railway clubs as it is enjoyed by the Master Car Builders' Association in connection with local discussions of interchange rules.

That a committee of three members be appointed by the President to confer with a similar committee of the Master Car Builders' Association and present for discussion next year a constitution and by-laws of a new association to combine the American Railway Master Mechanics' Association and the Master Car Builders' Association into a consolidated association, this committee to also report the advantages and disadvantages of such consolidation, considering the question from every standpoint.

A committee to report next year to consider a systematic plan for stating operating costs controlled or influenced by the motive power department, in order to facilitate recommendations as to motive power policy and render it possible to make intelligent and fair comparisons.

*Report presented at the annual convention of the American Railway Master Mechanics' Association. Committee: D. F. Crawford, F. H. Clark, T. H. Curtis.

†Special committee report presented at the annual convention of the American Railway Master Mechanics' Association. Committee: L. G. Parish, F. H. Clark, B. P. Flory.

LOCOMOTIVE BOILER INSPECTION.*

Your committee appointed to consider the proposed government regulations for the construction and inspection of locomotive boilers would recommend the adoption by the association of the following minute:

We, members of the American Railway Master Mechanics' Association, at our regular annual convention, June, 1909, considered, among other subjects, Senate Bill No. 236, presented by Senator Burkett to the 61st Congress, "to promote the safety of employes and travelers upon railways by compelling common carriers by railway to equip their locomotives with safe and suitable boilers and appurtenances thereto."

It is the opinion of the association that such a law is entirely unnecessary and will not promote any greater safety of operation, for the following reasons:

First—That the railways maintain efficient systems of inspection and tests of locomotive boilers and appurtenances under carefully prescribed rules, which are prepared to best meet general and local conditions, the railways having the greatest possible interest in the thoroughness of this protection.

Second—Experience covering a period of many years has shown conclusively that such failures of locomotive boilers as have occurred would not be eliminated by the proposed law, as investigation has shown that they were not due to defective design, construction, weakness or lack of proper appurtenances or periodical inspection.

We would, in addition to the above, recommend that the subject be given full consideration by the executive committee.

ACME AUTOMATIC MULTIPLE SPINDLE SCREW MACHINE.

The exhibit of the National-Acme Manufacturing Company, Cleveland, Ohio, covers one of its No. 56, 2¼-in. (chuck) capacity "Acme Automatic" multiple spindle screw machines, shown herewith. The machine is set up on a 1¼x4½-in. hexagon head cap screw, made from steel bar. The demonstration is one of the interesting features of the conventions, and the quality and quantity of the work is being favorably remarked upon by the many mechanical men who are taking an especial interest in the possibilities of the machine and in the company's new motor and single belt drives.

The general principles of the machine involve four bars of stock being acted upon at one time, the work being so divided that but one set of ordinary screw machine tools is required to get an output of 20 pieces per hour, with the machine running, as expressed by one master mechanic, at a "good, substantial, businesslike speed." The tooling is as follows: First spindle—Form head, with side forming tool and at the same time, with end box mill, remove stock one-half the length of screw. Second spindle—Remove balance of stock with second end box mill. Third spindle—Cut thread. Fourth spindle—Cut off screw with side cut off tool.

The fourth spindle becomes the first after the finished piece has been cut off and the bar fed out to a swinging gage stop. The threading mechanism is of particular interest to those interested in good threads, in that the die is revolved while the stock spindle is held stationary. The

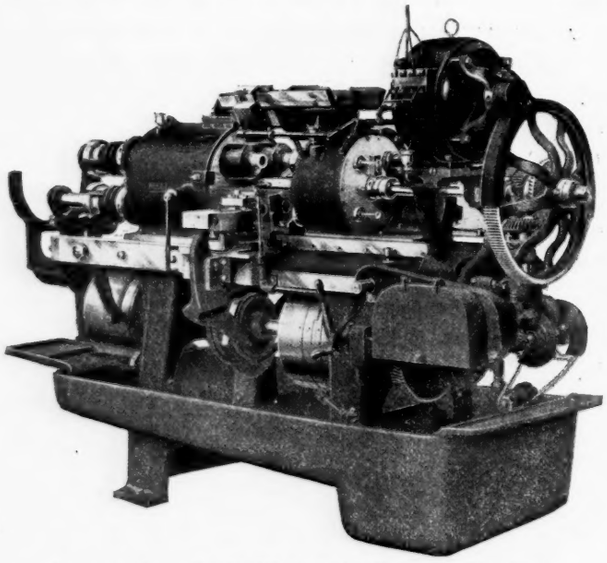
*Special committee report presented at the annual convention of the American Railway Master Mechanics' Association. Committee: D. F. Crawford, A. E. Manchester, William McIntosh, T. H. Curtis.

mechanism provides for revolving a die or tap at any speed desired, regardless of the speed of any other tool or tools in the series. The oil is pumped through the die spindle, through the die onto the work, thus insuring proper lubrication at a vital cutting point and preventing an accumulation of chips in back of the die, the oil force being sufficient to constantly wash the chips out of the die.

The new motor-drive is powerful without requiring a motor of excessive horsepower and the machine is converted into a single M-belt-drive by the simple substitution of a pulley in place of a gear wheel. The interest shown by the various master mechanics in this exhibit would seem to indicate continued and increasing orders from the railway shops. The following are the chuck capacities of the different sizes:

No. 51	full	automatic	.....	¼	in.	chuck	capacity
" 515	"	"	.....	5/16	in.	"	"
" 52	"	"	.....	⅜	in.	"	"
" 53	"	"	.....	1	"	"	"
" 54	"	"	.....	1⅜	"	"	"
" 55	"	"	.....	1⅝	"	"	"
" 56	"	"	.....	2¼	"	"	"

The sales organization is in charge of Mr. W. S. Chase, with headquarters at the Cleveland factory. Branch offices



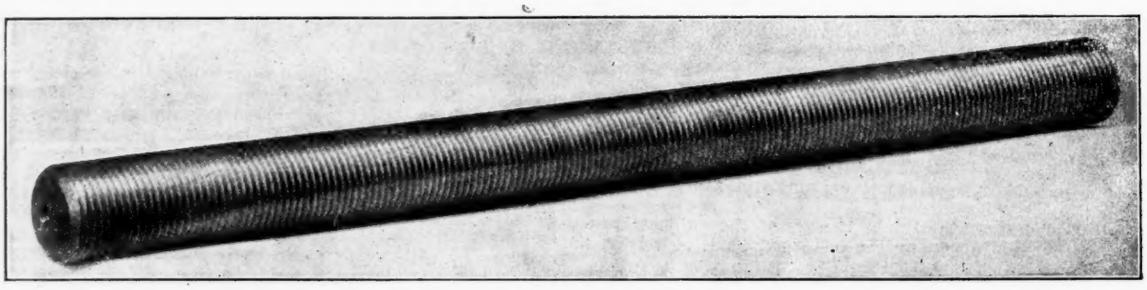
Acme Automatic Multiple Spindle Screw Machine.

are located at 77 White street, New York, in charge of L. M. Waite, handling southern and eastern territory, with the exception of the New England states; 141 Milk street, Boston, in charge of M. M. Brunner, handling the New England territory; 56 West Washington street, Chicago, in charge of E. C. Woolgar, handling western territory.

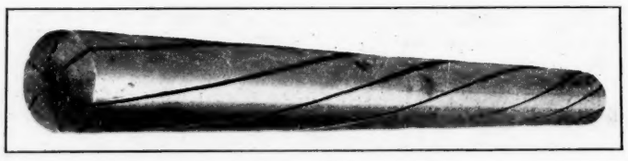
The designing and handling of special feature tools and attachments for complicated work is all under the personal supervision of E. C. Henn, Gen. Supt., who is also the designer of the machines.

LAMINATED FLEXIBLE STAYBOLT.

An interesting improvement in making flexible staybolts can be seen at the exhibit of the Scully Steel & Iron Co., Chicago, booths No. 542 and 543. In the manufacture of this bolt, iron is grooved longitudinally, at six equally distant points to a depth of a little over half the radius. The bolt is then given a twist, so that it has the appearance shown in the accompanying cut, before it is entirely closed up. In this way, results have been obtained which have heretofore been approached only by very intricate and special piling of the iron before being rolled. The bolt, as delivered to the customer, has the same appearance and is susceptible to the same treatment as regular staybolt iron, but its special construction, it is claimed, will eliminate all danger of crystalization and fatigue, which causes the failure of even the best staybolt material when used in a solid section. It is impossible to localize a crystalizing strain, either tensile or comprehensive, in any one set of fibers on account of the rotation of the outer fibers in the form of a spiral about the central or neutral axis. Since the bolt has little resistance in bending, the bending stresses in it are small and its resistance to longtitudinal tension is still about equal to that of the solid bar. The tests of this staybolt iron show that it is capable of resisting 500,000 vibrations, which is many times that shown by the solid bar under similar conditions of tests.



Laminated Flexible Staybolt.



Laminated Flexible Staybolt.

BASEBALL GAME—NOTICE.

The special trolley cars for the baseball game between the Railway and Supply teams will leave from South Carolina avenue and the Boardwalk on Saturday at 2.30 p. m. Admission to the grounds will be by badge only. The parade will start from the pier at 2 p. m. sharp. Members of the teams are requested to be at the entrance to the pier in uniform at 1.45 p. m.

H. J. Ballman, the "hair-felt" man, who has always been a regular attendant at the conventions and who, in the Daily of Wednesday morning was announced as about to make his headquarters with the H. W. Johns-Manville company, will not be present this year. He is detained in New York on business incident to the recent change of the selling agency of the American Hair Felt Company by which the Johns-Manville Company becomes sole agent in place of Baeder-Adamson Company. Mr. Bellman now becomes manager of the hair-felt department of the former company.

Exhibitors and Others

The St. Clair brake is in operation at booth 367. It consists of a cast-iron cylinder containing four separate and distinct air chambers. In one end of this cylinder is mounted a piston, which forms a movable dividing wall between the pressure and application chambers. In the application chamber is installed a nest of steel compression springs representing a force in normal or applied position equal to the maximum air force of power brakes now in use. Mounted on a bracket, cast on the cylinder for the purpose, is a distributing valve (having the usual brake pipe connection), which responds to the usual variation of brake pipe pressure, distributing air at the proper time and in the proper degree, which controls the movement and action of the brake piston.

The operation is as follows: Air passes from brake pipe connection through passages provided for the purpose to both the right and left side of the distributing valve piston, and into pressure chamber one (1) and two (2), which, in normal position, are in communication. Air in chamber one opposes the nest of steel compression springs as application chamber in this position registers to atmosphere. When standard brake pipe pressure is reached (say 70 lbs.) the steel compression springs are opposed by a difference of nearly 900 lbs. in favor of the release, causing the brake piston to travel to its extreme left and against its seat, in which position the brake is in full release or running position.

The brake has emergency, retarded release and straight air features, but it is difficult to explain these without the aid of diagrams and sectional views. Those interested are advised to see the brake in regular operation on the pier. It has been in regular service on 16 cars on the Copper Range Railway, and is now being installed on 50 freight cars for test on the Santa Fe at the Raton Mountain grade.

* * *

Edwin R. Kent, J. H. Kent and J. T. Stafford, representing Edwin R. Kent & Co., are stopping at the Traymore and greeting old and making new friends.

* * *

Greene, Tweed & Co. have a new self-lubricating packing for hydraulic and moderate steam pressures. This is known as the "Manhattan," and is made of flax fibre with a cotton cover. The thorough lubrication of each strand before braiding makes the packing practically frictionless; it does not swell and interfere with the free action of the pump in either hot or cold water service.

* * *

George A. Rees, assistant to the president of the Chicago Pneumatic Tool Company, arrived in Atlantic City Wednesday to attend the conventions. This is Mr. Rees's first visit to the M. C. B. and M. M. gatherings. His home is in Chicago.

* * *

John H. Ristine Union Draft Gear Company, who is going about with his hand in a sling, has become weary of answering questions as to what is the matter with it. So he now hands out a card with the inscription, "Not burned with a Cardwell gear or side-bearing. Just a furnace explosion. Ristine." This is like the answer of J. M. Warner, general manager of the Chicago & Western Indiana to questions as to how he lost his arm: "Run over by a steamboat."

* * *

The excellent workmanship embodied in compressed end Monitor bolsters is well shown at the exhibit of the Chicago Railway Equipment Co. A separate channel iron is used to show better how this compressing is done.

* * *

The Joseph Dixon Crucible Co., Jersey City, N. J., is calling attention to the fact that where its silica-graphite paint has been subjected to a strong corrosive action and the covering or existing film of the vehicle has been eaten away, the silica and graphite, because of their chemical inertness, have completely protected the lower portions of the vehicle and arrested further deterioration under very trying conditions.

* * *

One of the most effective and least costly additions that can be made to a shop equipment is the Wallworks universal electric lamp bracket, manufactured by the Wells Light Manufacturing Co., Jersey City, N. J. The particular features of these brackets, of which there are nine regular sizes, are their utility, construction and price. The latter is really startling to anyone who examines them and notes the labor expended thereon. They are made of black, enameled iron and are built to withstand rough handling.

* * *

The National sash lock, manufactured by the National Lock Washer Co., Newark, N. J., is standard on many roads, and is giving most satisfactory service, as it is strong in construction and simple in operation. Owing to the mechanical construction of this device, it is impossible for the window to fall and injure anyone. It would be welcomed into the field of car construction if only for this fact, without any of its other desirable features. The manufacturer claims that, as this sash lock is installed on the outside of sash, there is no expense entailed in cutting away part of the sash, and if it does not operate correctly, the trouble is immediately discovered and can be remedied without any delay.

* * *

Hiram G. Hammett, the effervescent and ever-genial, from Troy, is holding forth at space 149 in Machinery Hall. He is exhibiting a radius grinder, with all bearing surfaces thoroughly protected by dust guards.

* * *

The Linde Air Products Company, Buffalo, N. Y., is exhibiting its system of oxy-acetylene welding just north of the Convention Hall. A plant has been installed for making demonstrations with its different-sized blow-pipes, and judging from the number of people that watch these demonstrations daily, the oxy-acetylene system, although not as yet extensively used in railway shops, is commanding a good deal of attention as a quick and thorough welding process and as a cutting off tool. Take time to see it.

* * *

The L. M. Booth Company of New York and Chicago has installed on Young's pier a full-size water softening plant in operation. This is the only convention at which a complete plant of this kind has been shown. The apparatus is so large that special provision was made to install it as an exhibit outside the building. The novel feature of the type "F" Booth water-softener is the placing of the regulating apparatus as well as the solution tanks at the ground level. The simplicity of construction and ease of operation have been commented upon most favorably by railway men acquainted with actual requirements. A 15,000-gallons-per-hour Booth water-softener is now under construction for the Rock Island at Sayre, Okla. The company has prepared a most attractive book, which is not only handsome, but instructive, and is distributed free.

* * *

W. E. Bryant, of the Michigan Lubricator Company, Detroit, Mich., received yesterday, while attending the convention, an order for 144 triple Bull's-Eye locomotive lubricators, to be sent to South America.

* * *

The Baker-Bawden glass and number plate holder for headlights, which is being exhibited in the booth of the Commercial Acetylene Company on one of the headlights of the acetylene company, has been receiving considerable attention on account of its simplicity. It is claimed that an immense sav-

ing in time and labor over other methods of holding front glasses and number plates is possible by its use.

* * *

C. H. Treat, M.E., chief designer of the American Blower Company, Detroit, arrived Thursday to attend the conventions. Mr. Treat is the inventor of the "A. B. C." vertical enclosed self-oiling engine for driving generators for stationary service and electric car lighting. He is quartered at the Traymore with R. T. Coe, of the same company.

* * *

The Scullin-Gallagher Iron & Steel Company, St. Louis, Mo., said to be operating the largest basic open-hearth steel foundry in this country and producing over 300 tons of finished castings per day, makes a specialty of railway castings, including bolsters, truck side frames, couplers, freight car underframes, locomotive frames, driving wheel centers and miscellaneous parts of all kinds from 1 to 80,000 lbs. in weight. This product is said to be uniform, thoroughly annealed and free from all surface defects that would increase the cost of machining.

* * *

The Ohio Seamless Tube Company, of Shelby, Ohio, is represented at the convention for the first time. E. D. Giberson, who was formerly with the National Tube Company, is here in its interest.

* * *

The Planet Company, a new company, organized by a few substantial business men of Chicago, to deal in railway supplies, equipment and specialties, with headquarters at 1303 First National Bank building, Chicago, is making an exhibit in Space No. 445 (annex). Thomas P. Convey, the manager of the company, is in charge. He is showing the Summers vestibule curtain hook and the Eclipse curtain shade fixture.

* * *

The H. W. Johns-Manville Company, New York, Spaces 492 and 493, is exhibiting a very interesting line of asbestos products, including all forms of insulation. Of particular interest at this time is the Ceilinite linings, which are used extensively for insulating steel passenger equipment cars. The J-M Car-best-us roofing is especially adapted for cars and locomotive cabs. It is not affected by burning cinders, acids, or gases of combustion, or extremes of heat and cold.

* * *

Experts on malleable iron will be interested in the crushed journal boxes in The T. H. Symington Company's booth. Experts on "Symington quality" are there to tell what happened to those boxes.

* * *

The American Blower Company's representatives call their advertising man "Return Trap" Coe, because of his enthusiasm for Detroit return steam traps, exhibited in actual operation at their booth in Annex Court.

* * *

The National Railway Devices Company, Chicago, at Booth 319 is exhibiting a product of the Rubbertex Cloth and Paper Co., Chicago, for car and station roofs. It consists of canvas duck saturated with a composition of asphalt and slag, rendering it absolutely water, frost and weatherproof. This treatment also increases the tensile strength fully 75 per cent. This cloth was graded at 100 per cent. in a competitive test at Washington, D. C. During the convention, it is receiving the particular attention of P. P. Hinckley, who is one of the National Railway Devices Company's staff this year.

* * *

The exhibit of the Stoever Foundry & Manufacturing Company, Myerstown, Pa., at booth 118 in Machinery Hall, is attracting considerable attention. A No. 2 motor driven automatic pipe bending machine and an 8-in., 1909 model, standard pipe machine are both in operation and practical demonstrations are constantly being made. The No. 2 automatic pipe bending machine is designed to bend 1-in., 1¼-in., 1½-in. and 2-in. pipe, the radius of bend varying between the limits of a minimum radius of 2½ in. for 1-in. pipe to a maximum radius of 12 in. for all four sizes of pipe. This machine bends the pipe without the use of fillers or heating. The 1909 model of the standard pipe machine is designed to insure great strength, stability and durability. An essential feature of this machine is in the die stand. A front opening die ring exposes the interior mechanism which facilitates the withdrawal and insertion of chasers. The machine has a short cutting-off distance of 3 in. Ed. R. Euston is in charge.

* * *

A number of loving cups and favrile vases shown by the Parkesburg Iron Company demonstrate the superior quality of its charcoal iron and the skill of its blacksmith.

* * *

The Garlock Packing Co., Palmyra, N. Y., is exhibiting at space 420 a complete line of its high grade fibrous and metal packings for general shop purposes; special packings for air pumps and throttles and a new high pressure sheet packing for superheated steam. The latter is a domestic sheet, as are all other Garlock products, and it is claimed to be superior to all similar imported superheat sheet packings.

* * *

The operation of high speed trains, such as the 20th Century Limited and Pennsylvania 18-Hour Special, which are to use the new L. N. brake equipment, have shown the necessity of a stiffer brake beam than those used heretofore, and the Chicago Railway Equipment Company was requested to design a beam which would not deflect more than $\frac{1}{16}$ in. under center load of 40,000 lbs. The difficulties of the problem were due to the contracted space now found when axle lighting is used, and to the requirement that the brake heads should interchange with those previously used on the Pullman equipment. These were the 2½-in. National Hollow beam and the "Diamond Special." The Chicago Railway Equipment Company has just manufactured and listed a beam to meet these unusual severe requirements, and the results of the tests are given in the following telegram:

"CHARLES H. WILLIAMS, JR., Hotel Dennis:

"Preliminary tests of the new high speed creco brake beam shows a deflection .06 in. under load of 40,000 lbs. and .064 under load of 46,000 lbs. E. B. LEIGH."

* * *

The Pressed Steel Car Company, Pittsburgh, Pa., has no exhibit, but it has a mighty fine reception booth—No. 515. In addition to an attractive arrangement of palms and flowers, the wall is hung with large framed pictures, showing some of the many classes of steel cars for passenger and freight service that the concern builds, together with reproductions of some of the Pressed Steel Car Company's specialties—bolsters, trucks and brake-beams. The company is represented by O. C. Gayley, C. E. Postlethwaite, J. S. Turner, J. H. Mitchell, L. O. Cameron, F. von Hiller, J. H. Regan, W. H. Wilkinson, F. M. Robinson, J. G. Bower, C. D. Terrell, V. von Schlegell, G. H. Glover, Jr., M. S. Simpson, C. D. Jenks, G. T. Merwin and Charles A. Lindström.

* * *

Locomotive No. 574, on the Central of New Jersey Railroad, in regular passenger service between New York and Atlantic, has been equipped with the Baker-Pilliod valve gear. Railway men at the conventions are invited to inspect this installation any day on the arrival of the train at Atlantic City at 6.45 p. m.

* * *

The old sun shines on Kennicott water softeners the world over. Here are a few of the many installations of this well-known apparatus: Krupp Gun Works, Essen, Germany; Carnegie Steel Co., Pittsburgh; De Beers Diamond Mines, Kimberly, Africa; Rand Gold Mines, Johannesburg, Africa; Metropolitan Railroad, Paris, France; Jones & Laughlin Steel Com-

pany, Pittsburgh; Imperial Peking Railway, China; South India Railway, India; South Australian Railways, Australia; American Steel & Wire Company, Pittsburgh; Copper Queen Consolidated. The use of the Kennicott method of water treatment for locomotives in this country is well known.

* * *

The American Car & Foundry Company, New York, at their works, Berwick, Pa., is building 500 cars for the Delaware, Lackawanna & Western, which will require 260,000 Bartley fasteners or 520 fasteners per car, every nut and bolt being secured by Bartley fasteners. The Bartley fasteners are manufactured by the American Nut & Bolt Fastener Company, Pittsburgh, Pa. This company has booth 330.

* * *

Strong, Carlisle & Hammond Co., Cleveland, O., have just taken the sole agency for the Randall graphite sheet lubricator; but owing to lack of time they were unable to prepare an exhibit. R. E. Carpenter, who is stopping at Chalfonte, is in attendance and will be glad to explain the points of interest and the construction of the Randall lubricator.

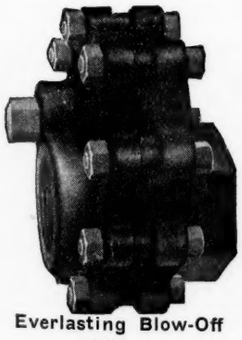
EXHIBITION SAMPLE CAR.

The steel under-frame car exhibited in Machinery Hall by the Scullin-Gallagher Iron & Steel Co., St. Louis, Mo., embodies several new features in car construction which are attracting considerable attention. The ends of the car comprising the bolster, end sill, buffer, draft sill and draft sill braces are combined in one integral casting, made of sufficient strength to withstand all stresses. The ends are bound together with commercial rolled sections, the center sill being reinforced with truss rods to obtain the required strength. This type of construction eliminates a large percentage of the rivets usually found in built-up under-frames, and the application of commercial sections materially reduces the cost of construction.

The car is equipped with various specialties, manufactured by the Scullin-Gallagher Co., including the Excel coupler, cast steel truck bolsters and four distinct types of truck side frames, and, in addition, all castings used on the car also made of cast steel. The Scullin-Gallagher Co. is also marketing a type of under-frame which is admirably adapted to reinforcing old equipment, as it is built along the same general lines as the car on exhibition, with the exception that no side sills are used.

EVERLASTING BLOW-OFF VALVE.

The Everlasting blow-off valve shown herewith is largely used in stationary service where a strong, substantial, dependable article is needed. It is claimed that it needs no attention at all from the engineer after being installed, being self-grinding and self-compensating at all points. It is composed of a top and bottom bonnet, a disk, and a lever and post, and is quite simple. A wrench is placed upon the square head at the left and pushed down to open the valve, and reversed to close it; the effort to open it being in the 2-in. size, about 25 lbs. on an 8-in. lever against 200 lbs. steam pressure (about one-fifth that necessary to operate most plug cocks). The two bonnets are set together upon an approved high-pressure gasket with machine bolts, giving quick access to the inside, should it ever be necessary to renew the disk or reface the seat. The entire working part of the valve is easily renewed and refaced, a monkey wrench and file being the only tools needed.



Everlasting Blow-Off Valve.

The operating post is set tight upon a ground joint and held there by a stiff bronze spring, doing away with a stuffing box and making the joint tight as long as the valve lasts. It need not be touched after leaving the factory, as it constantly grinds itself to a true seat at each operation. The inlet orifice is tapered just above the seat, increasing the velocity of the "blast" at this point and insuring its delivery into the discharge pipe without punishment to the seat, as would be the case were this precaution not taken. It also has the effect of siphoning the valve clean at each operation. The clearance spaces within the valve have been made ample to avoid the possibility of clogging, and numerous tests have been made to prove that the valve will work as well discharging mud or putty as it will with pure water.

It is made in all sizes of the following types: (1) Iron body, working parts of naval bronze. (2) Semi-brass, top bonnet cast from special grade imported iron; bottom bonnet, brass; working parts, naval bronze. (3) Solid brass, with working parts of naval bronze. All are made in both screwed and flanged types. Every valve is subjected to a live steam test of 250 lbs. and worked under that pressure before leaving the factory. The Scully Steel & Iron Co., Chicago, is the maker.

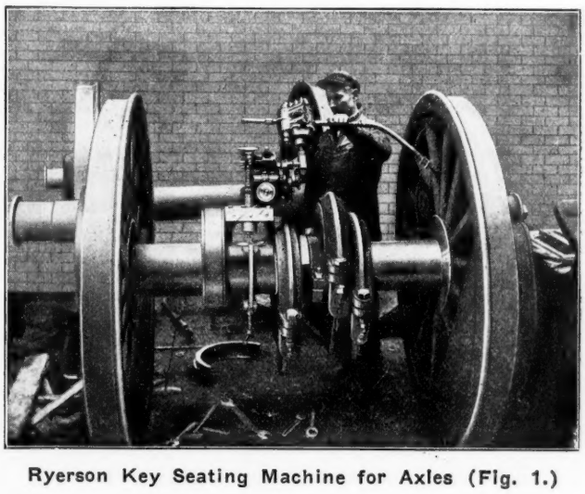
IT PAYS TO ADVERTISE.

One day this week a member of the executive committee lost his cane, wrote a "Lost" notice and handed it in to the office of The Daily. In less than an hour and before the copy reached the printer he had recovered his cane.

RYERSON KEY-SEATING MACHINE.

The Ryerson portable automatic key-seating machine is designed for automatically cutting key-ways in locomotive axles either before or after the engine is assembled. The advantages of a machine of this kind will be apparent to every mechanical man who is acquainted with the difficulties met in locating and cutting key-seats for the eccentrics.

The machine illustrated cuts the key-way in a small part of the time required by other methods. In addition to the saving of time, the work done by the machine is practically perfect

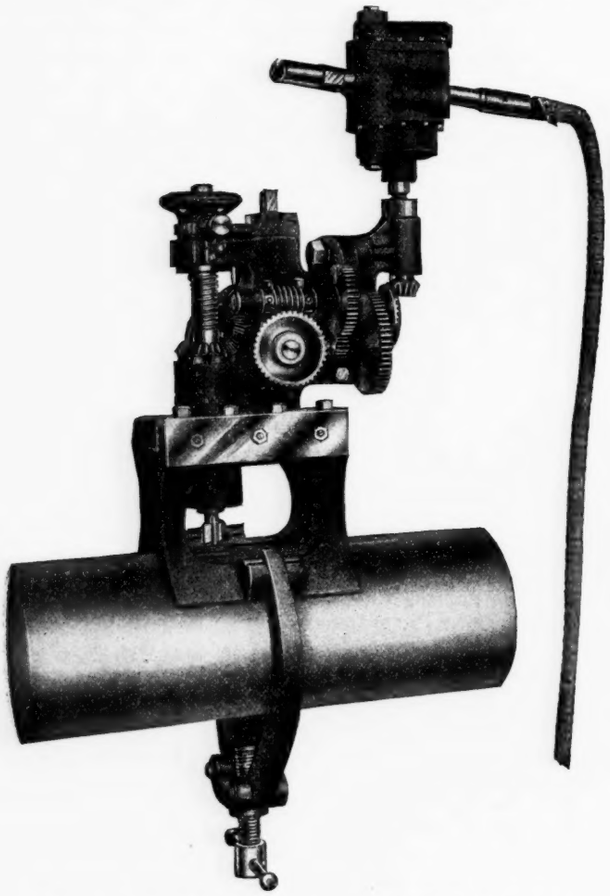


Ryerson Key Seating Machine for Axles (Fig. 1.)

and standard in size. Its use avoids all possibility of the key-seat in the axle and eccentric not corresponding, which is often the case when key-ways are cut before the wheels are pressed on the axle. For repair work where the old driving axle is retained, it frequently happens that the key-way in the eccentric and the axle do not correspond. This is now avoided by the use of an offset key. The Ryerson portable key-seater can be used for recutting the old key-way in the axle to cor

respond with the eccentric, thus obviating the necessity of using an offset key with its correspondingly weakened construction.

The machine is so designed that it will cut as close as one inch from the driving box, while, on the other hand, the adjustment is such that any standard size key-way can be cut.



Ryerson Key Seating Machine for Axles (Fig. 2.)

It is so designed that the cutting is done within the base of the machine, thus making the machine compact and permitting its use for eccentric cutting on axles where the distance between the eccentrics is very limited. The base of the machine which fits on the axle is 8½ in. long over all.

The machine is operated by an air drill or electric motor, as the illustration shows, the motor being connected by a taper shank, which is part of the machine. The motor should operate at between 300 and 450 revolutions per minute. Both the vertical and horizontal feed of the machine are automatic so that no attention is required beyond the placing of the tool in position. The machine weighs approximately one hundred pounds. It is handled exclusively by Joseph T. Ryerson & Son, Chicago.

The Chicago Car Heating Company is showing its standard straight vapor system under steam as arranged for a standard wooden passenger coach; also its "Flexible Vapor System" as applied to some 800 sleeping cars and steel coaches. The latter system is arranged to permit of the regulation of temperature in proportions of 20 per cent., 30 per cent., 40 per cent., 50 per cent., 60 per cent., 70 per cent., 80 per cent. or 100 per cent. of the total heating power of the apparatus. As compared with this modern and perfected vapor system an interesting feature of the exhibit is the original combination vapor and pressure system as first used by the company in 1904, the disadvantages and complications of which have been overcome in the present flexible straight vapor system.

COES WRENCHES.

The accompanying illustrations represent the latest features in the Coes wrench line and are especially interesting from the fact that they are intended primarily for engine room and railway use under the most trying conditions.

The steel handle wrench, which is made in sizes from 4 in. to 21 in., is intended for heavy duty in exposed service, and

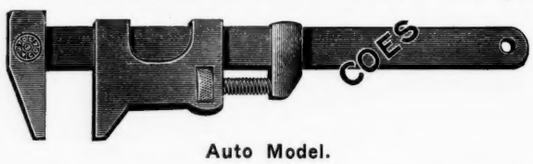
Steel Handle.

owing to the fact that the handle is of metal the tool is impervious to water, heat or steam. The handle shell itself is a semi-steel casting of special material and internally supported so that it cannot be crushed, the construction being patented. Beyond this there has been a change made in the screw, the thrust or downward pull being taken upon a hardened steel ball, and the slot in the bar, which previously held the head

Key Model.

of the screw is done away with. This adds to the strength of the bar about 30 per cent. Repeated tests by the larger railways, both in this country and of South America, prove this wrench capable of more work than any wrench of the kind ever presented to the consuming trade.

The Key model wrench, which was originally presented in one size (28 in.), is now made in four sizes, the largest of which is 72 in. long and opens 12 in., having a weight of 165 lbs. The intermediate sizes are 36 in. and 48 in., opening,



Auto Model.

respectively, 6¼ in. and 9½ in. These wrenches are all furnished with an eye in the end of a handle to take a hook or to attach safety cord or chain falls. These wrenches in themselves replace a vast number of special tools, and an engine room supplied with two of them is fitted for all nuts within the capacity of the largest size bought.

The Coes Wrench Co., Worcester, Mass., has also presented a new special 12-in. wrench known as the Auto model, the extreme thickness of this wrench being ⅝ in.

CAST STEEL PASSENGER CAR PLATFORM END-SILL.

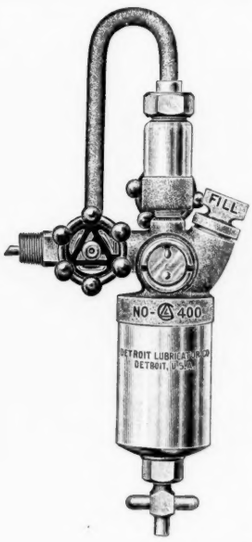
The Gould Coupler Company, Depew, N. Y., has designed a cast sill, with self-contained friction buffer, for a cast steel platform end-sill on all-steel passenger cars. This design eliminates a separate housing for a friction buffer and simplifies the construction and number of parts necessary with the older type. The platform buffer is pivoted and retained on the follower of the friction buffer mechanism by the pull-back springs of the side stems. This allows flexibility of the buffer plate in taking curves, avoiding excessive lateral resistance and sharp wheel flanges.

The friction buffer mechanism is contained in the cast steel end-sill. Openings in the top of the sill allow for inspection or renewal of the plate springs and wedges of the friction part. The threshold, or lap-plate, covers these openings, excluding any excessive amount of dirt from the friction parts. No extra labor is required for applying the friction buffer, the cast steel end-sill being fitted complete with the device. The steel end-sill may be designed with lugs, for use with any type of steel under-frame.

The whole arrangement is simple, mechanical and effective, and is adapted to any desired construction of steel underframe, either of the box-girder or eye-beam type. The form and shape of sill can be changed, as can the capacity of the friction buffer, this latter by the removal or addition of the leaf springs which engage the side wedges. This mechanism of a cast steel end-sill with an integral friction buffer is new and a step in advance of previous methods.

DETROIT, No. 400, SIGHT FEED LUBRICATOR.

The accompanying illustration shows a single connection lubricator, made by the Detroit Lubricator Company, Detroit, Mich., and one which is designed for use on traction engines, steam pumps, etc. There are but two valves, one for water, and the other for the oil. The lubricator is made in one casting, and as there are no joints and a minimum of parts, the possibility of leaks is practically eliminated. A combination of gage glass and sight feed is provided and the bullseye glasses are made thick to prevent breakage. The drops of water, passing down between the two glasses with light on either side, are always visible. As every drop of water displaces a drop of oil, a steady and easily regulated feed to the cylinders may be maintained. The Detroit Lubricator Company is exhibiting in spaces 379-81.



CARDWELL FRICTION DRAFT GEAR.

The Cardwell friction draft gear is represented again this year among the exhibits, but the name of the company handling the device is the Union Draft Gear Company. Perhaps the idea is that in "Union" there is strength. There is not only strength in the Cardwell friction draft gear, but much else of merit.

The exhibit of the company is out on the pier underneath the big tent—booth numbers 476 and 477. You will find it either coming or going. There you will find one of the interesting features of the convention displays, a miniature drop testing machine. It shows that a sparing in absorbing a blow simply lengthens the stop, while the Cardwell friction draft gear both lengthens the stop and absorbs the shock without recoil.

WESTINGHOUSE ENAMELED RESERVOIRS.

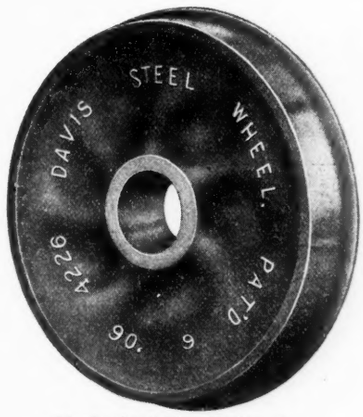
Iron and steel tanks exposed to the elements are subject to deterioration due to oxidation. New surface is presented as the rust scales drop off, which operation, if allowed to continue, will cause the tank eventually to collapse. To prevent this action the Westinghouse Air Brake Co., Pittsburgh, Pa., has developed a process for enameling reservoirs.

All of these enameled reservoirs are carefully designed and built in accordance with present railway requirements. The material used in barrels and heads is carefully inspected. All rivets are hydraulically driven to fill the holes, rendering calking unnecessary. No copper liner or any other material is used in making joints. All tapped holes larger than ¼ in. in diameter are reinforced to give sufficient strength for thread, making the reservoirs safe for high pressure, a feature which also applies to the brazed and welded types.

The reservoirs when built are thoroughly cleaned by an acid process, then neutralized in an alkali bath, and are carefully washed and dried after each operation. All scale having been removed, they are heated and dipped in a tank of warm enamel, after which they are baked at an even temperature in a specially arranged oven. This special process of dipping and baking, during which two coats of flexible enamel are applied to the inside and outside of the steel tanks, absolutely prevents rust and detrimental action due to acids or to other agencies. The metal surface thus coated may be considerably distorted before the enamel will crack.

DAVIS CAST STEEL WHEEL.

The American Steel Foundries is showing in its exhibit a Davis cast steel wheel, which is attracting favorable attention. The special feature of this exhibition wheel, which has three triangular sections cut out of its circumference, is the extreme solidity of the metal, as shown at these sections. From the appearance of these surfaces this wheel is as solid as a rolled steel section. This wheel is a fair sample of the advancement that has been made in steel castings in the last few years.



Davis Cast Steel Wheel.

ONE-PIECE TRUCK FRAME.

Careful inspection of the Bettendorf one-piece truck frame, shown at booth 200, will convince you that it is a logical development of the built-up arch bar frame. With this frame before you, only a few words in explanation are necessary to prove that there are no objections to it from any standpoint. Over 8,000 sets of trucks are now being built at the Bettendorf shops and with these in use there will be over 26,000 on the various roads of the country.

As the arch bars, columns, spring seat and journal boxes are combined in a single casting, there will be less repair work and therefore decreased cost of maintenance. In case the journal box should fail, the side frame is replaced at cost of a malleable journal box.

There are other advantages of the one-piece side frame and if you are fully acquainted with it you have an opportunity to receive a complete explanation at the Bettendorf exhibit. You should know why this radical change in construction retains the good features of the old arch bar truck and removes the objectionable ones.

As to service, you are not required to take the Bettendorf Axle Company's word because the test of years is already recorded.

WESTINGHOUSE CENTRIFUGAL DUST COLLECTOR.

Pipe scale, sand, cinders, dirt, or foreign particles of any kind frequently produce undesirable results and imperfect operation when carried into the working parts of the brake system, particularly the triple valve. In view of this fact, the Westinghouse Air Brake Co., Pittsburgh, Pa., has given much attention to the problem of excluding such foreign matter by means of strainers in the branch pipe from the brake pipe.

Recent investigation in connection with what is designated as the Westinghouse centrifugal dirt collector, however, indicates that a marked advance has been accomplished along this line. The operation of this device is illustrated by means of a specially arranged rack showing that, due to the combined action of centrifugal force and gravity, dirt or other foreign material is automatically eliminated from air flowing through the collector—as when the brakes are applied or released—without restricting the flow in any way. This method of keeping dirt out of the brake system, as amply demonstrated, has been shown to operate with indeed remarkable efficiency.

Greene, Tweed & Company have in their booth a "Favorite" reversible ratchet wrench on a wrench board ready to be hung in an engine room. The wrench board contains the wrench and all its attachments—head, extension and socket. This wrench may be used in narrower places than an ordinary wrench. Its motion is continuous until the nut is seated or removed; an opening through the head allows the nut to pass clear through. Reverse motion is made instantly by the turning of a pawl.

SPEED CHANGE MECHANISMS FOR CONSTANT SPEED DRIVE MILLING MACHINES.

On machines equipped with the cone drive, the different spindle speeds are obtained by changing the driving belt from one step to another on the cone pulleys. The great variation of available power, due to the position of the belt on the cone steps, however, was one of the factors leading to the development of the constant speed drive.

The principal feature of this type of drive consists of a wide face pulley, of large diameter, on the main shaft of the machine. This pulley runs at a constant high velocity, so some means of obtaining the necessary changes of spindle speeds had to be devised. A system of gearing, trained in various ways on the different makes of machines, has been universally adopted for this purpose.

On the line of machines exhibited at the conventions by the Brown & Sharpe Manufacturing Co., Providence, R. I., this mechanism is of especial interest and its simple, yet efficient, construction quickly appeals to even the inexperienced eye. It consists of a train of gears leading from the main shaft of the machine to a gear on the spindle sleeve; from here power is transmitted to the spindle either by means of locking pins located near the front spindle box or through the back gears. Incorporated in this train is a cone gear having four steps or, practically speaking, four gears of different diameters and numbers of teeth.

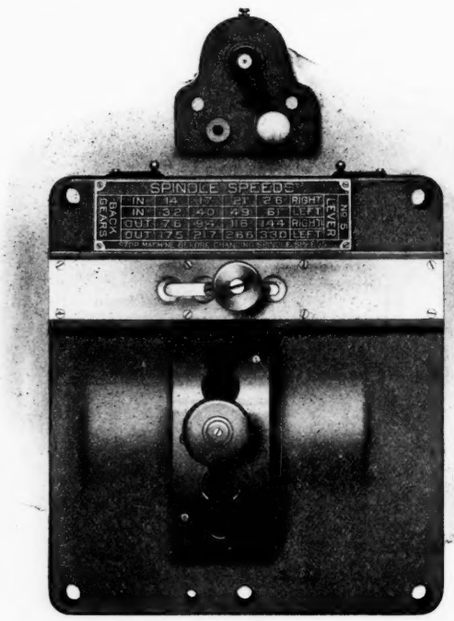
Power is communicated to this cone gear by means of a solidly mounted, swinging tumbler gear that meshes continually with a long faced pinion on the main driving shaft, but may be slid into position to mesh with any one of the steps of the cone gear. A strong hardened steel lever, (shown in cut) provides means for bringing the tumbler gear into mesh with the gear of the four-step cone.

Another point in connection with the throwing in and out of mesh of the tumbler gear is the ability to do so when the gears are in any position,—made possible by constructing the gears with special pointed teeth.

A series of four speeds are obtained by means of the four-step cone and tumbler gear; these are doubled by means of a sliding quill gear on the spindle sleeve which also meshes with two gears of the four-step cone; the resulting eight speeds are again doubled by use of the back gears,—giving in all, a series of 16 changes.

In an accompanying cut, the large lower lever controls the throwing in and out of mesh of the tumbler gear; the knob above controls the sliding movement of the tumbler gear; and the top lever controls the sliding movement of the quill gears. The back gears are thrown in and out of mesh in the usual manner.

An index plate, situated on the speed case, gives direct


SPINDLE SPEEDS
BACK GEARS
IN 14 17 21 26 RIGHT
IN 32 40 49 61 LEFT
OUT 76 94 116 144 RIGHT
OUT 175 217 266 330 LEFT
LEVER No 5
STOP MACHINE BEFORE CHANGING SPINDLE SPEEDS

Speed Change Mechanism.

readings and methods of obtaining the different changes of speeds. The following example serves as a good illustration of the simplicity of this arrangement:

Wanted spindle speed of 116 R.P.M.
Throw back gear out, if necessary.
Turn upper lever to right, if necessary.
Drop tumbler gear lever to lowest position.
Slide index knob along until under column containing the desired speed.
Raise tumbler gear as far as it will go, when the tumbler gear will engage the proper gear. As soon as the lever is released it locks itself by sliding into a machined recess.

The feed changing mechanism of this machine is of about the same construction as the spindle speed mechanism and

SPINDLE SPEEDS						
BACK GEARS	IN	14	17	21	26	RIGHT
	IN	32	40	49	61	LEFT
	OUT	76	94	116	144	RIGHT
	OUT	175	217	266	330	LEFT

LEVER No 5

STOP MACHINE BEFORE CHANGING SPINDLE SPEEDS

Index Plate.

needs no detailed explanation. It may be readily seen that the simplicity is so pronounced that the chances of the operator becoming confused, when making different changes of levers, are exceedingly remote.